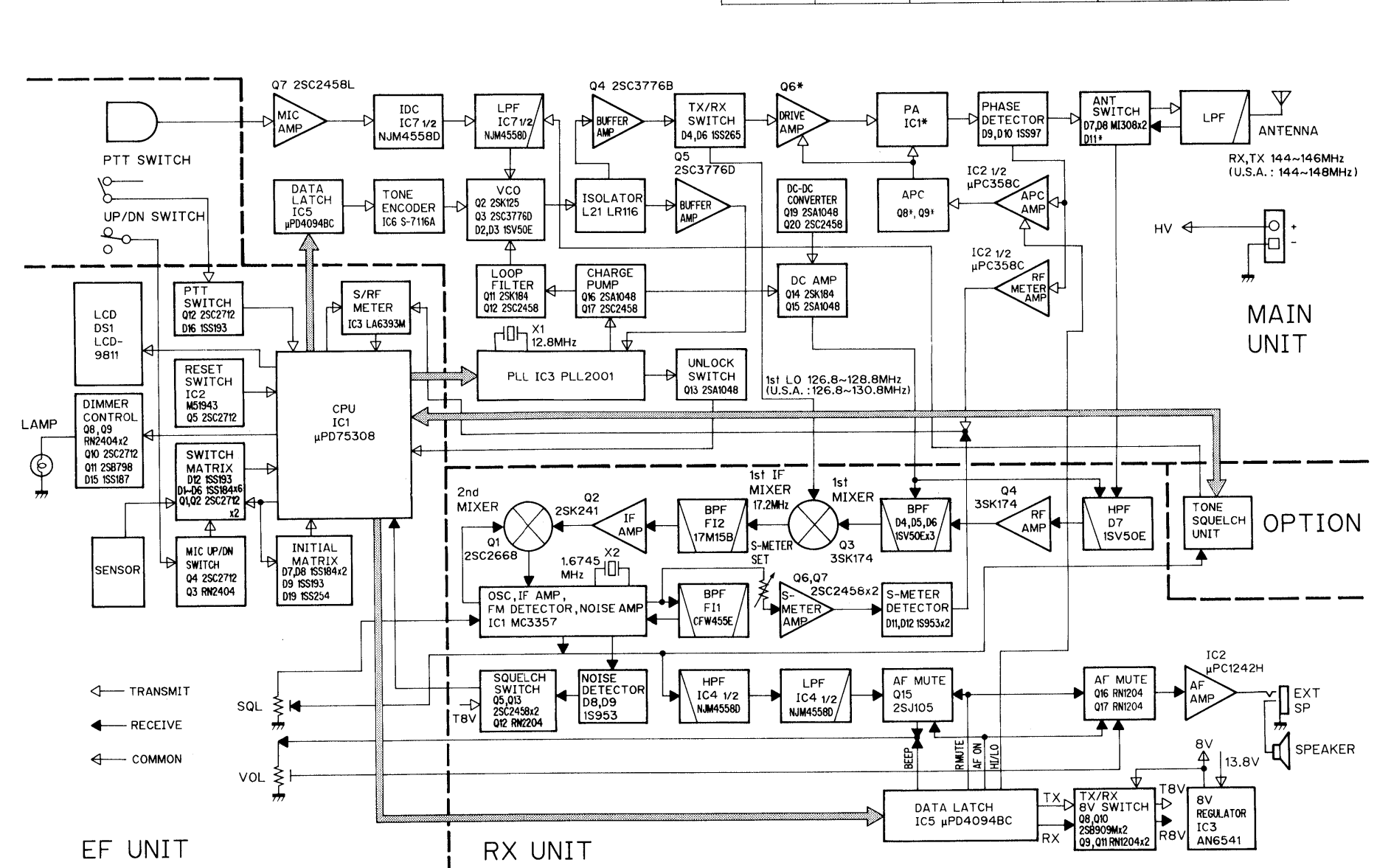
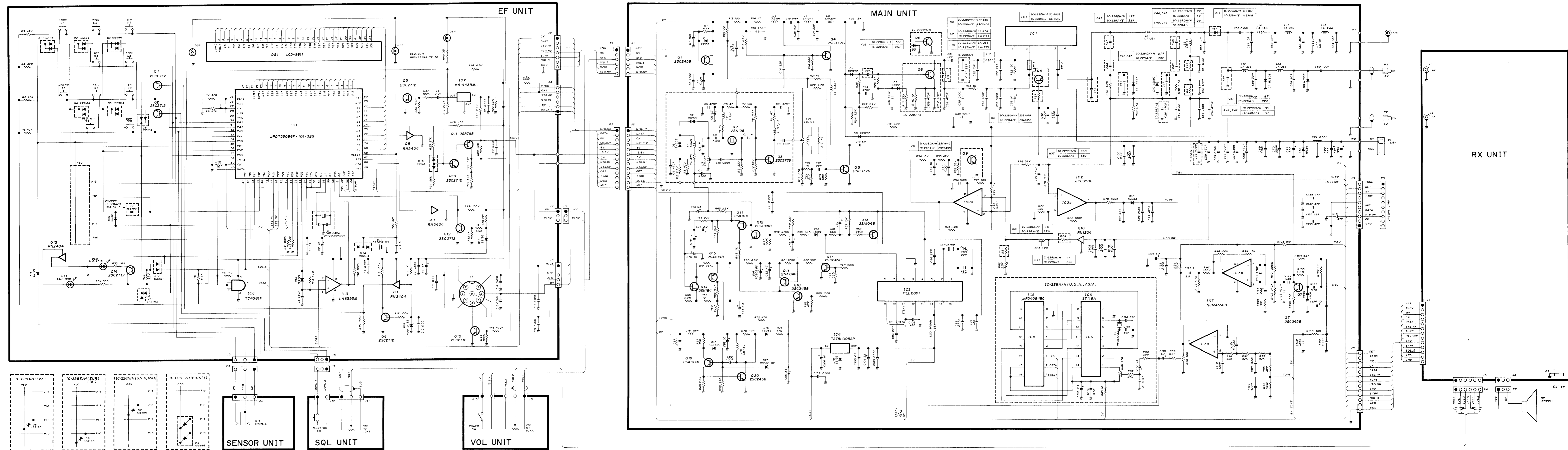


BLOCK DIAGRAM

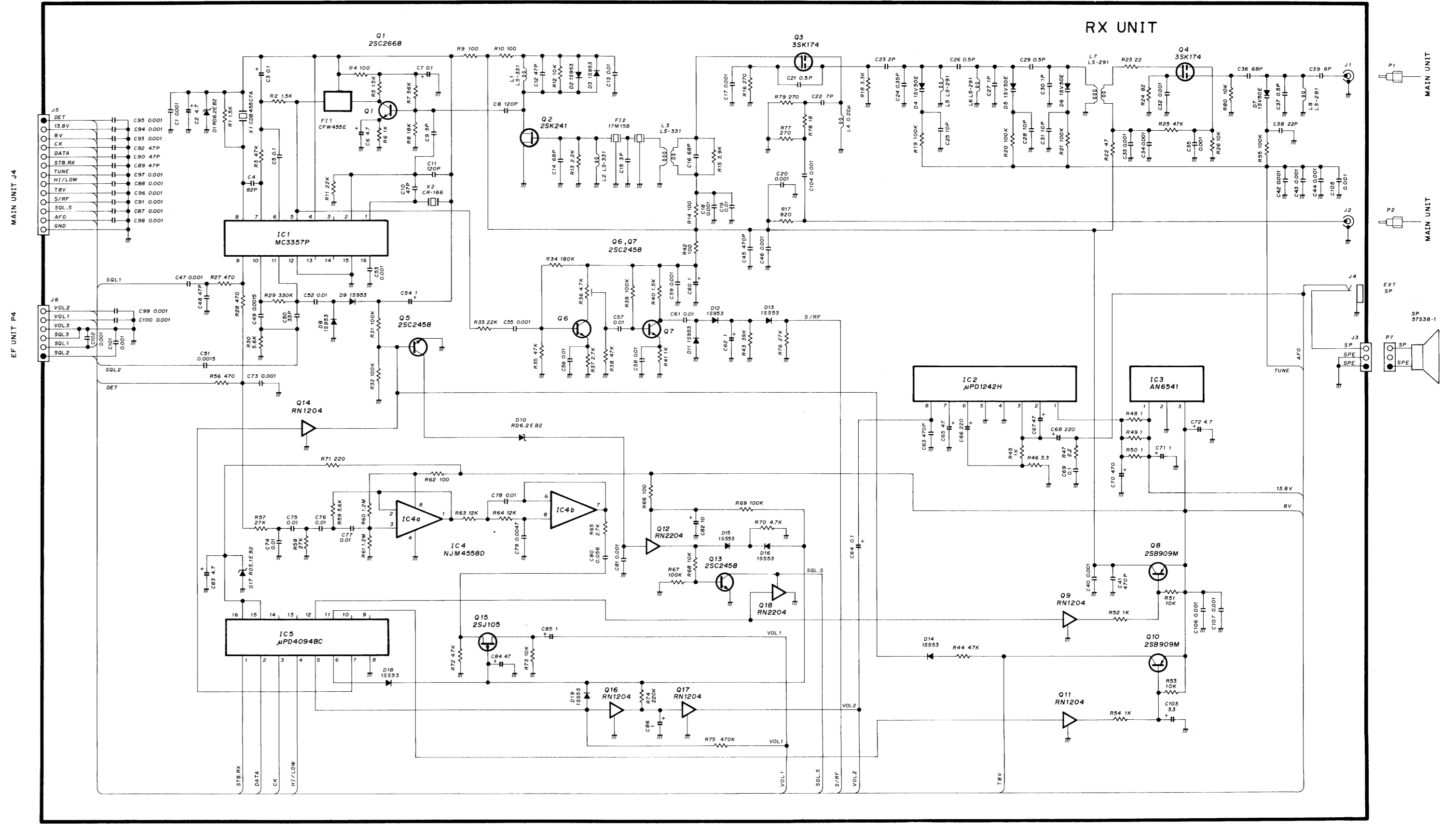


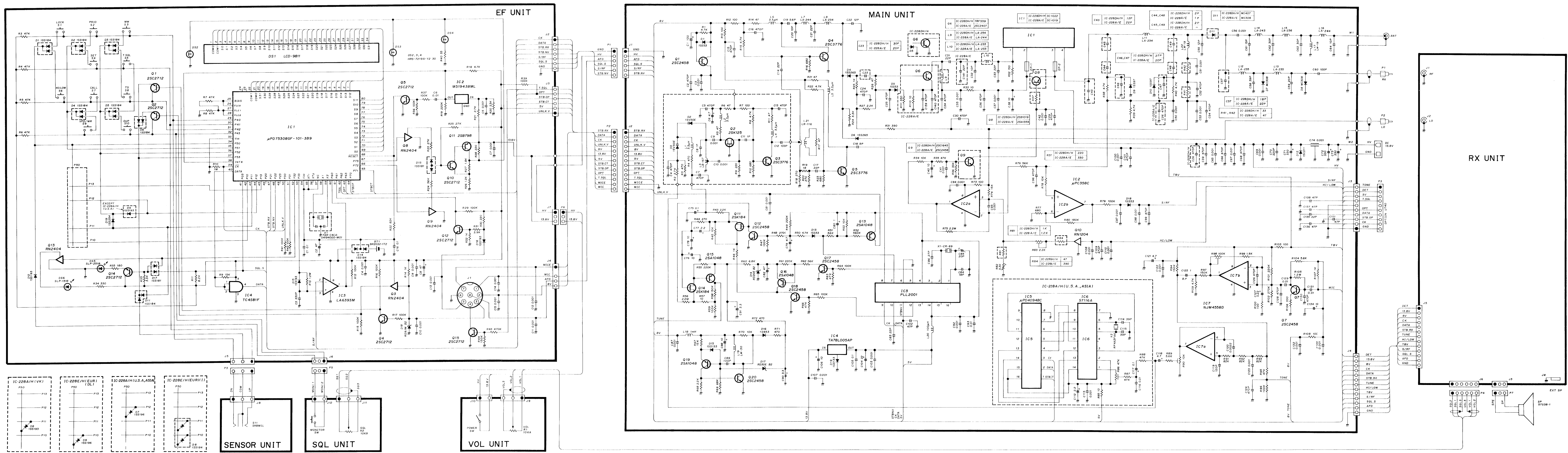
MODEL	IC-1	Q6	Q8	Q9	Q11
IC-228A/E	SC-1019	2SC2407	2SA1359	2SC2458	MI308
IC-228H	SC-1022	TRF559	2SB1019	2SC1645	MI407

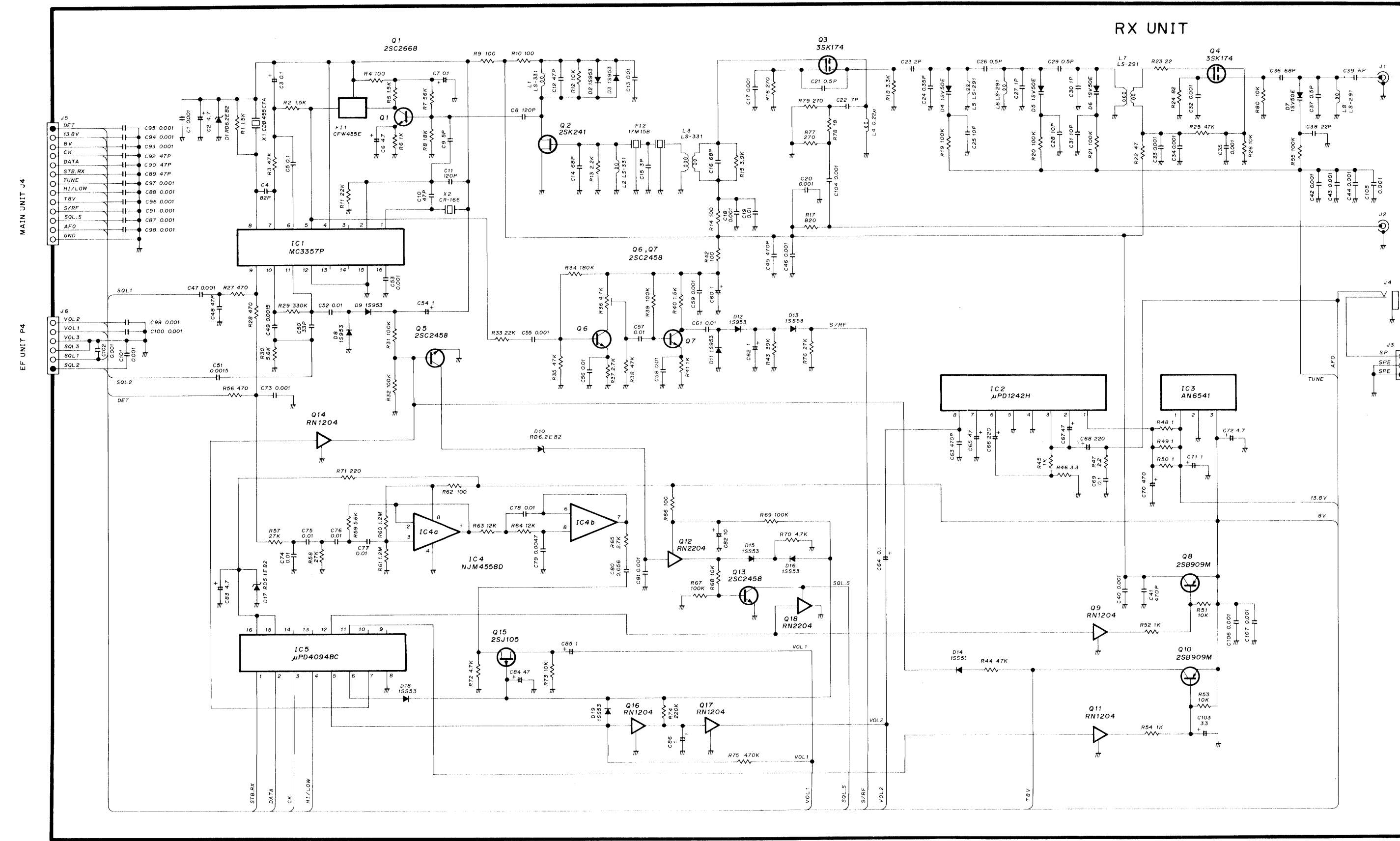
To upgrade quality, some components may be subject to change without notice.



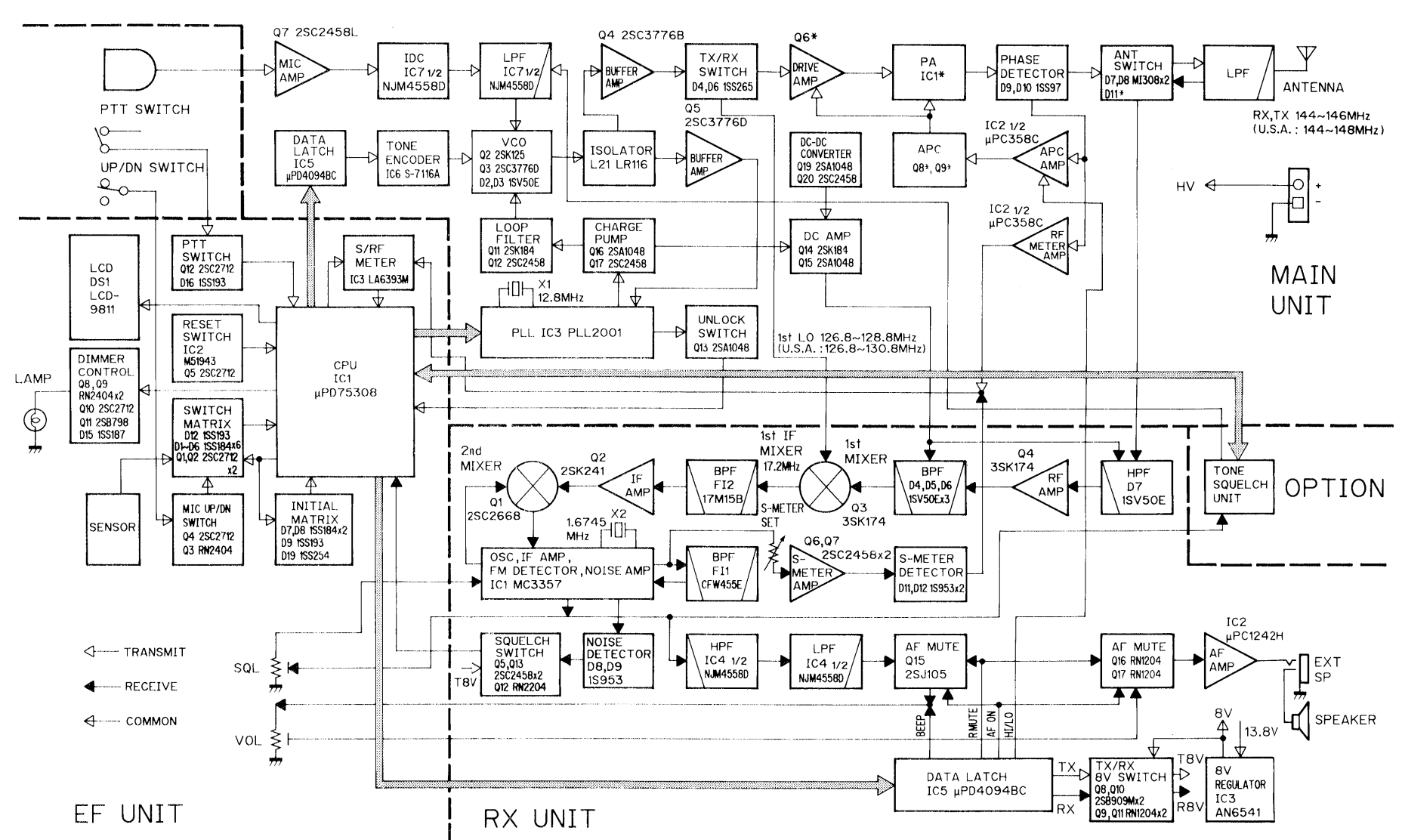
To upgrade quality, some components may be subject to change without notice.







BLOCK DIAGRAM



MODEL	IC-1	Q6	Q8	Q9	Q11
IC-228A/E	SC-1019	2SC2407	2SA1359	2SC2458	MI308
IC-228H	SC-1022	TRF559	2SB1019	2SC1645	MI407

To upgrade quality, some components may be subject to change without notice.

ICOM

144MHz FM TRANSCEIVER

IC-228A (USA VERSION)

IC-228E (EUROPEAN VERSION)

IC-228H (GENERAL HIGH POWER VERSION)



MULTI-COLOR LIQUID CRYSTAL DISPLAY (LCD)

Icom introduces a color LCD for easy viewing. Orange, red and green highlight the numbers and letters displayed in black. Light up your 2 meter life.

45W OUTPUT POWER

You'll never be at a loss to make that distant repeater. Using a custom designed power module as the power amplifier, this transceiver outputs 45W. 25W model also available.

EXTRA LARGE HEATSINK

An extra large, efficient heatsink is built in to ensure continuous heat dissipation while transmitting.

20 MEMORY CHANNELS FOR YOUR CONVENIENCE

Each of the 20 memory channels stores all the information required to work a repeater. Throw those frequency lists away.

PROGRAMMED SCAN AND MEMORY SCAN

The Programmed Scan function scans all frequencies between two programmable scan edge frequencies. The Memory Scan function scans all memory channels in succession, except those you choose to skip.

PRIORITY WATCH

Priority Watch monitors the Call Channel, a memory channel or all memory channels in succession every five seconds — while you operate.

POCKET SLED® AND TONE SQUELCH

When the UT-40 TONE SQUELCH UNIT (sold separately) is installed, the IC-228A/E/H alerts you only if selected calls are received. When the frequency of a received tone equals the tone frequency you've set, a 30 second alarm is emitted over the speaker. Never miss a sked.

MONITOR THE REPEATER INPUT FREQUENCY INSTANTLY

It's so easy to check the input frequency when working a repeater. Simply push the squelch control on the front panel to open the squelch and check the frequency.

COMPACT, LIGHTWEIGHT AND EASY TO OPERATE

This transceiver provides you with so many features. But it's so light and compact that it fits under your dashboard. The front panel is designed for convenient operation.

Icom Inc.

SPECIFICATIONS

GENERAL

- Frequency coverage

MODEL	VERSION	RECEIVER	TRANSMITTER
IC-228A, IC-228H	USA	138.00~174.00MHz*	140.10~150.00MHz*
IC-228A, IC-228H	Australia	144.00~148.00MHz	144.10~148.00MHz
IC-228A, IC-228H	Asia	138.00~174.00MHz*	140.10~150.00MHz*
IC-228E, IC-228H	Europe	144.00~146.00MHz	144.00~146.00MHz
IC-228E, IC-228H	Italy	140.00~150.00MHz*	140.00~150.00MHz*

*Specifications apply to 144.00~148.00MHz.

- Mode : FM (F3)
- Tuning step : 5, 10, 15, 20 and 25kHz
(USA, Australia, Asia versions)
12.5 and 25kHz
(Europe, Italy versions)
- Memory channels : 20 and 1 Call Channel
- Antenna impedance : 50Ω (unbalanced)
- Power supply requirement : 13.8V (±15%) DC (negative ground)
- Current drain (at 13.8V DC) : Receive/max. audio output 800mA
Receive/standby 450mA
IC-228H
Transmit/HIGH output power 9.5A
Transmit/LOW output power 3.5A

IC-228A, IC-228E
Transmit/HIGH output power 6.0A
Transmit/LOW output power 3.0A
- Usable temperature range : -10°C~+60°C (14°F~140°F)
- Frequency stability : ±10ppm (-10°C~+60°C) (14°F~140°F)

- Dimensions : IC-228A, IC-228E
140(W)×50(H)×137(D)mm
5.5(W)×2(H)×5.4(D) inches
IC-228H
140(W)×50(H)×159(D)mm
5.5(W)×2(H)×6.3(D) inches
- Weight : IC-228A, IC-228E 0.85kg 1.9lbs
IC-228H 1.1kg 2.4lbs

TRANSMITTER

- Output power : IC-228H HIGH: 45W
LOW: 5W
IC-228A, IC-228E HIGH: 25W
LOW: 5W
 - Modulation system : Variable reactance frequency modulation
 - Maximum frequency deviation : ±5.0kHz
 - Spurious emissions : Less than -60dB
 - Microphone impedance : 600Ω
- RECEIVER**
- Receive system : Double-conversion superheterodyne
 - Intermediate frequencies : 1st 17.2MHz
2nd 455kHz
 - Sensitivity : Less than 0.18μV for 12dB SINAD
 - Selectivity : More than 15kHz/-6dB
Less than 30kHz/-60dB
 - Squelch threshold sensitivity : Less than 0.11μV
 - Audio output power : More than 2.4W at 10% distortion with an 8Ω load
 - Audio output impedance : 8Ω

All stated specifications are subject to change without notice or obligation.

OPTIONS

- **HM-12** HAND MICROPHONE
- **HM-14** DTMF MICROPHONE
(Already supplied with the U.S.A. version.)
- **HM-15** HAND MICROPHONE
(Already supplied with Europe version.)
- **HM-16** SPEAKER-MICROPHONE
- **HM-17** SPEAKER-MICROPHONE
(1750Hz tone call switch included.)
- **HS-15** FLEXIBLE MOBILE MICROPHONE
- **HS-15SB** SWITCHBOX (for HS-15)
- **IC-PS30** AC POWER SUPPLY (13.8V DC, 25A)
- **PS-45** AC POWER SUPPLY (13.8V DC, 8A)
(For the IC-228A/E.)
- **SM-6** DESKTOP MICROPHONE
- **SM-8** DESKTOP MICROPHONE
- **IC-SP4** EXTERNAL SPEAKER (4Ω, 3W)
- **SP-7** EXTERNAL SPEAKER (8Ω, 5W)
(For base station operation.)
- **SP-10** EXTERNAL SPEAKER (8Ω, 5W)
- **SP-12** EXTERNAL SPEAKER (8Ω, 3W)
- **UT-40** TONE SQUELCH UNIT

Icom Inc.

6-9-16, Kamihigashi, Hirano-ku, Osaka 547, Japan Phone: 06 793 5301 Fax: 06 793 0013 Telex: 05277822 ICOMTR J

Count on us!

Icom America Inc.

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Telex : 152210 ICOM AMER BVUE

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Incorporated in Victoria
7 Duke Street, Windsor, Victoria, 3181, Australia
Phone : 03 529 7582 Fax : 03 529 8485
Telex : AA 35521 ICOM AS

Icom (UK) Ltd.

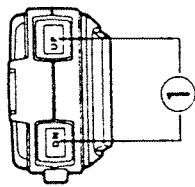
Unit 9, Sea St., Herne Bay, Kent, CT6 8LD, U.K.
Phone : 0227 363859 Fax : 0227 360155
Telex : 965179 ICOM G

Icom France S.a

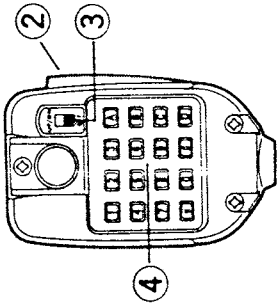
120 Route de Revel, BP4063, 31029 Toulouse Cedex, France
Phone : 61.20.31.49 Fax : 61.34.05.91
Telex : 521515 ICOM FRA

Your local agent/dealer:

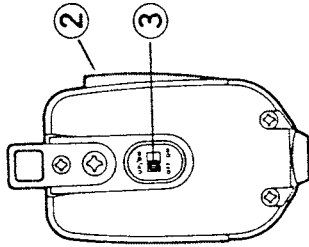
3-4 MICROPHONE



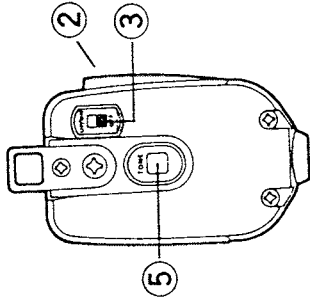
HM-14



HM-12



HM-15



①

UP/DOWN SWITCHES

Push either of these switches to change the operating frequency or memory channel.

Push and hold either of these switches to start scanning.

②

PTT SWITCH

Push to transmit.

③

UP/DOWN ON/OFF SWITCH

Prevents accidental changes of the [UP] and [DN] SWITCHES.

④

DTMF KEYPAD (HM-14 only)

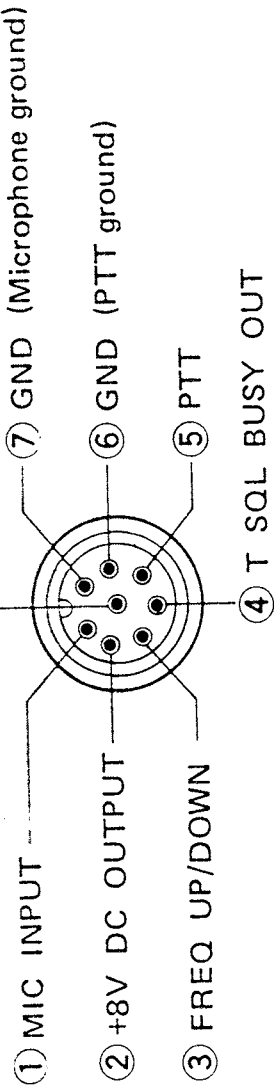
Produces DTMF signals while transmitting.

⑤

TONE CALL SWITCH (HM-15 only)

Transmits a 1750Hz tone signal.

• MIC CONNECTOR (Front panel view)



7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

- "TS" appears when the 1MHz step is selected. "TS" does not appear when the programmed step is selected.

Rotate the TUNING CONTROL to select the desired frequency.

Push [DUP] once for -duplex or twice for +duplex.

- Either of the following indicators appear on the FUNCTION DISPLAY.

"DUP-" : Transmit freq.
 = Receive freq. - Offset freq.

"DUP" : Transmit freq.
 = Receive freq. + Offset freq.

Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

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"DUP-" : Transmit freq.
= Receive freq. - Offset freq.

"DUP" : Transmit freq.
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Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

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The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

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To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

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"TS" does not appear when the programmed step is selected.

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Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

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The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

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- 2) Push [VFO/M] to select VFO mode.

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To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

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The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

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- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

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- "TS" appears when the 1MHz step is selected.
"TS" does not appear when the programmed step is selected.

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"DUP" : Transmit freq.
 = Receive freq. + Offset freq.

Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

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Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

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Push [VFO/M] to select MEMORY mode.

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Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

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Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

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The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

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Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

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The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

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Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

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7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

- "TS" appears when the 1MHz step is selected. "TS" does not appear when the programmed step is selected.

Rotate the TUNING CONTROL to select the desired frequency.

Push [DUP] once for -duplex or twice for +duplex.

- Either of the following indicators appear on the FUNCTION DISPLAY.

"DUP-" : Transmit freq.
= Receive freq. - Offset freq.

"DUP" : Transmit freq.
= Receive freq. + Offset freq.

Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].

7-2 MEMORY MODE

The transceiver has 20 memory channels. Each memory channel independently stores a frequency, duplex condition, offset frequency, subaudible tone frequency (U.S.A. and Asia versions) and the Memory Skip function.

- 1) Select the desired memory channel to be programmed.

Push [VFO/M] to select MEMORY mode.

- "M" appears on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired memory channel.

- 2) Push [VFO/M] to select VFO mode.

- "M" disappears from the FUNCTION DISPLAY.

- 3) Select the required contents to be programmed (operating frequency, repeater information, etc.).

Select the tuning step, 1MHz or programmed step with [TS].

- "TS" appears when the 1MHz step is selected. "TS" does not appear when the programmed step is selected.

Rotate the TUNING CONTROL to select the desired frequency.

Push [DUP] once for -duplex or twice for +duplex.

- Either of the following indicators appear on the FUNCTION DISPLAY.

"DUP-" : Transmit freq.
= Receive freq. - Offset freq.

"DUP" : Transmit freq.
= Receive freq. + Offset freq.

Push [SET] to access SET mode.

To select the subaudible tone setting display, push [SET] several times until "TONE" flashes on the FUNCTION DISPLAY.

Rotate the TUNING CONTROL to select the desired tone frequency.

Push [T/T.SQL] to turn a subaudible tone ON

"TONE" appears on the FUNCTION DISPLAY.

- 4) Push and hold [MW] until three beeps are emitted from the speaker.

- Memory writing has been completed. To check the contents, push [VFO/M].



Icom America, Inc.
 2380 - 116th Ave. N.E.
 Bellevue, Washington 98004
 (206) 454-7619

SERVICE BULLETIN

DW

Unit Model: IC-228

SB # 13888-001 Effective Date: 5/17/88

Serial No. Affected: 1000-1100 (NOT ALL ARE AFFECTED)

Product Group: AMATEUR

Background Information:

IC-228 Some units are not maintaining programmed memories.

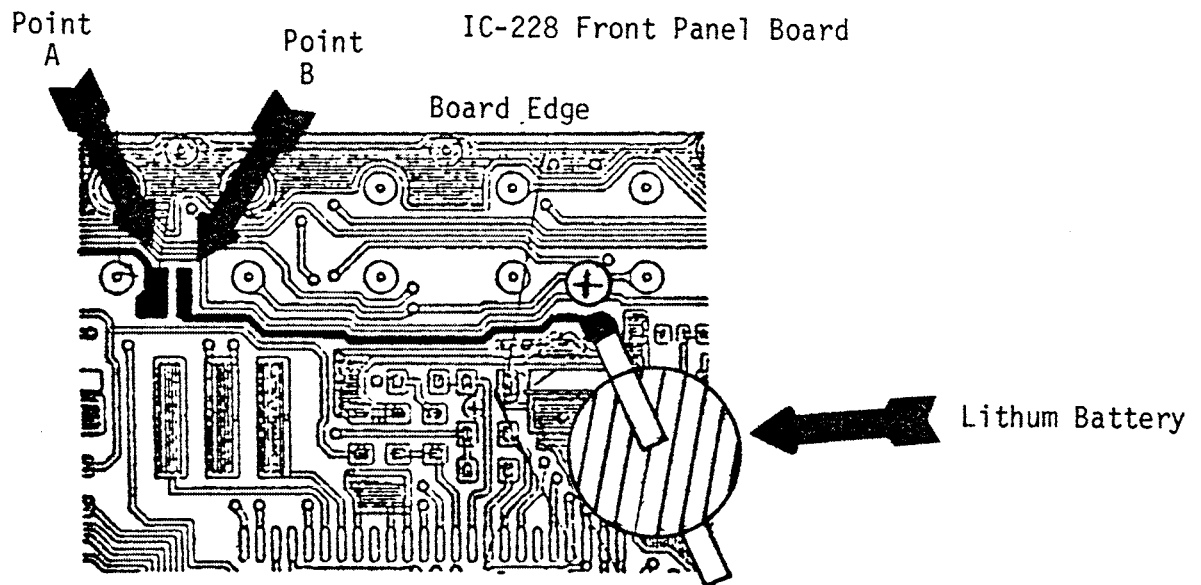
Technical Information:

There is a solder bridge that is missing to complete the lithium battery circuit, to maintain memories. The solder bridge needs to be made if not in place.

PROCEDURE:

1. Remove the top and bottom covers.
2. Remove front panel from main chassis of radio. Necessary to unplug J6 connector from the RX unit and connectors J1 and J2 from Main unit.
3. Locate solder pads for solder bridge, if not soldered, bridge between points A and B. See Figure 1 .
4. Replace front panel to main chassis of radio.
5. Replace top and bottom covers.

FIGURE 1



This Service Bulletin Consists of 1 pages total.

Estimated time to complete is 30 Minutes Maxium

Releases: Svc *MR* Eng *Bill* Mkt *EG*

THIS SERVICE BULLETIN IS TO PROVIDE INFORMATION ON CHANGES/IMPROVEMENTS TO EXISTING EQUIPMENT. ICOM ASSUMES NO LIABILITY OR RESPONSIBILITY FOR THE IMPROPER INSTALLATION OF THIS PROCEDURE.

S E R V I C E I N F O R M A T I O N

To : ALL ICOM Distributors

From : ICOM INCORPORATED. Osaka. Japan

Date :31.Oct.1988

No :079

Dear Sirs,

We are sending the technical information as shown below which is for the purpose of facilitating smoother services to your customers.

If you have questions,do not hesitate to contact us.

Subject : Modification of frequency range expansion for IC-228A/E/H
This modification affected From below serial No .

IC-228A : No. 02901 ~
IC-228E : No. 01501 ~
IC-228HA : No. 06301 ~
IC-228HE : No. 01901 ~

How to : See attached copies.

IMPORTANT !!

- 1) After modification, the frequency range will be expanded to the maximum frequency range that the transceiver has. However, the frequency range is not fixed. Because the PLL lock range is not the same as all transceivers and it depends on the transceiver.
- 2) We can not guarantee any specifications in the out of band regarding to the modification.

Yours very truly,

service Department
Y.Matsumoto

FACSIMILE TRANSLATION SUMMARY

FAX From: HOSHO / MATSUMOTO	Refer's to IJ FAX Dated:
FAX To: TAKAHASHI	Refer's to IJ Letter Dated:
Problem/Model IC 228H Problem	Date: May 11 88

Short Summary of Main Points:

Japanese version of IC-228 does not ship from factory yet.
therefore Japan does not have a problem
there is one possibility for losing memory.
if Lithium battery is not soldered, Radio will lose memory.
Please check solder bridge on ^{POSITIVE} ~~negative~~ side of Lithium
battery as show in attached picture

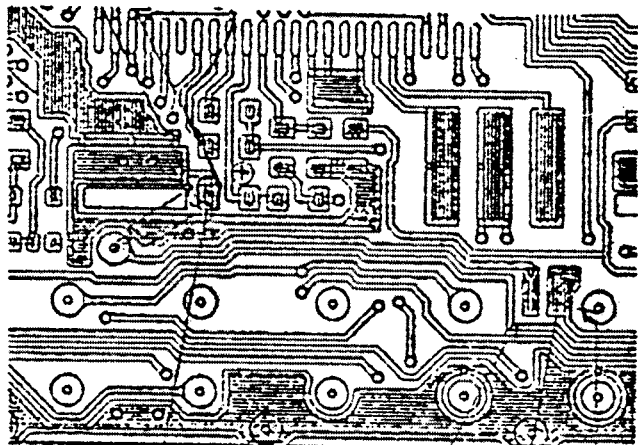
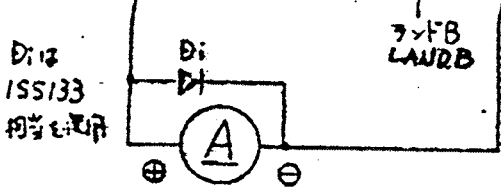
Summary Translation: _____ Immediate Dist. Req'd. _____ Routine Dist.
Full Translation: _____
FT Req'd By: _____

TRANSLATED BY -> **TAKA**

Distribution To: RWB KDS EG
 WBF DP
 PP SS
 MSA MD Other: (List) **RAKIB, KUN**

LOGIC UNIT ADJUSTMENT

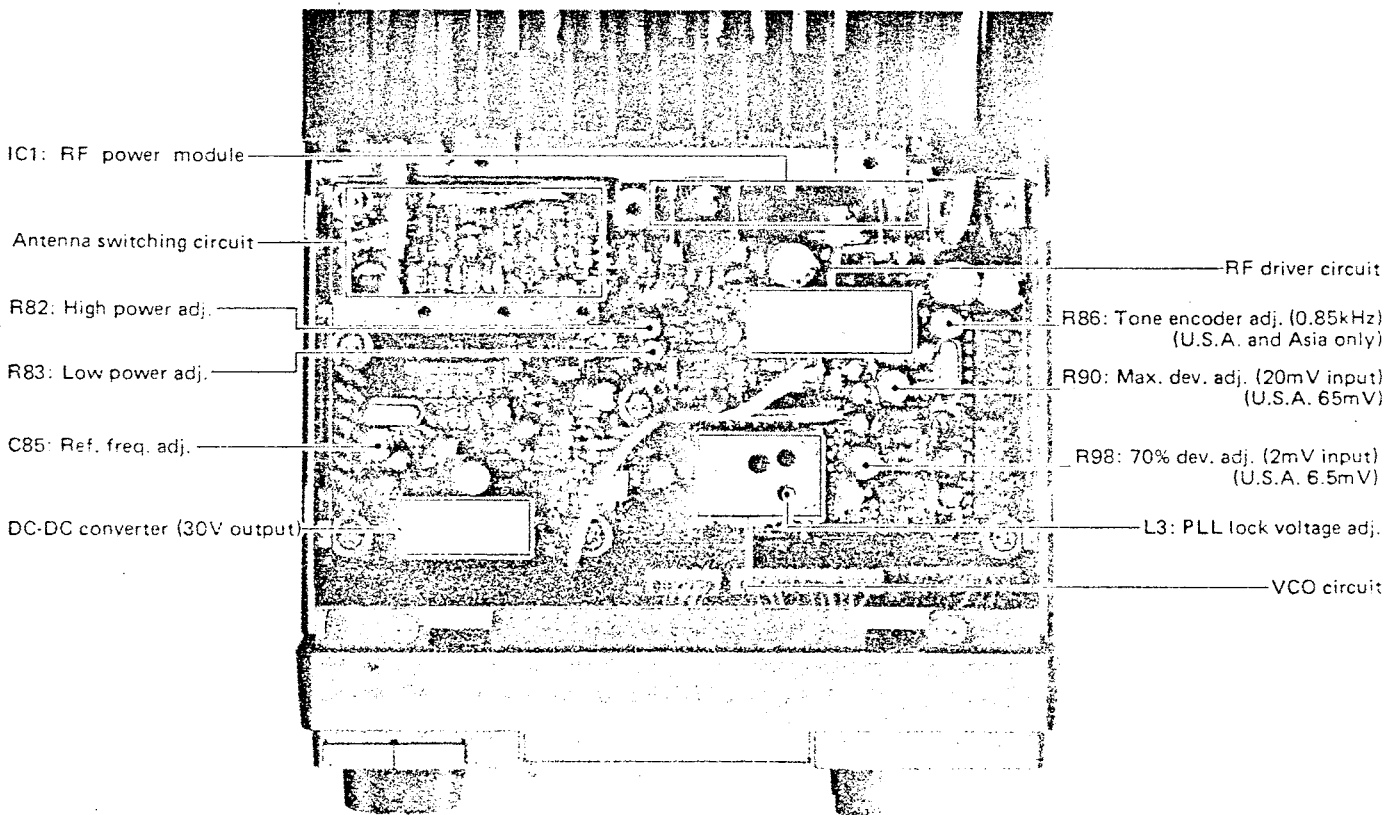
DATE 1988 / 1 / 30

Adjustment No	Adjustment Condition & Tuning	Value	REF No	CK. POINT
<p>バックアップ電流 チェック</p>	  <p>Diは ISS133 ダイオード</p> <p>ランドB LAORB</p> <p>ランドA LandA</p> <p>solder bridge between Land "B" and Land "A"</p> <p>IA IC228H Fig1 Xセル-たけのけ</p> <p>電源OFFの状態で、LOGIC基板上の BT1⊕電極、及び、ランドA (Fig1) に電流計をつなぎ、一旦、電源をONし、そ の後、電源をOFFにした時のバックアップ 電流を測定します。</p> <p>尚、測定後、ランドAとランドBを半田ブ リッジする事。</p> <p>↑ 羊田たけのけが参考になります。 1Vセルの電圧 check と共に 二の場所での check をお願いします。</p>			<p>(2/2)</p> <p>→ Takahashi</p> <p>Fig1 参照</p> <p>サービスマン 83.5.11 松本</p>

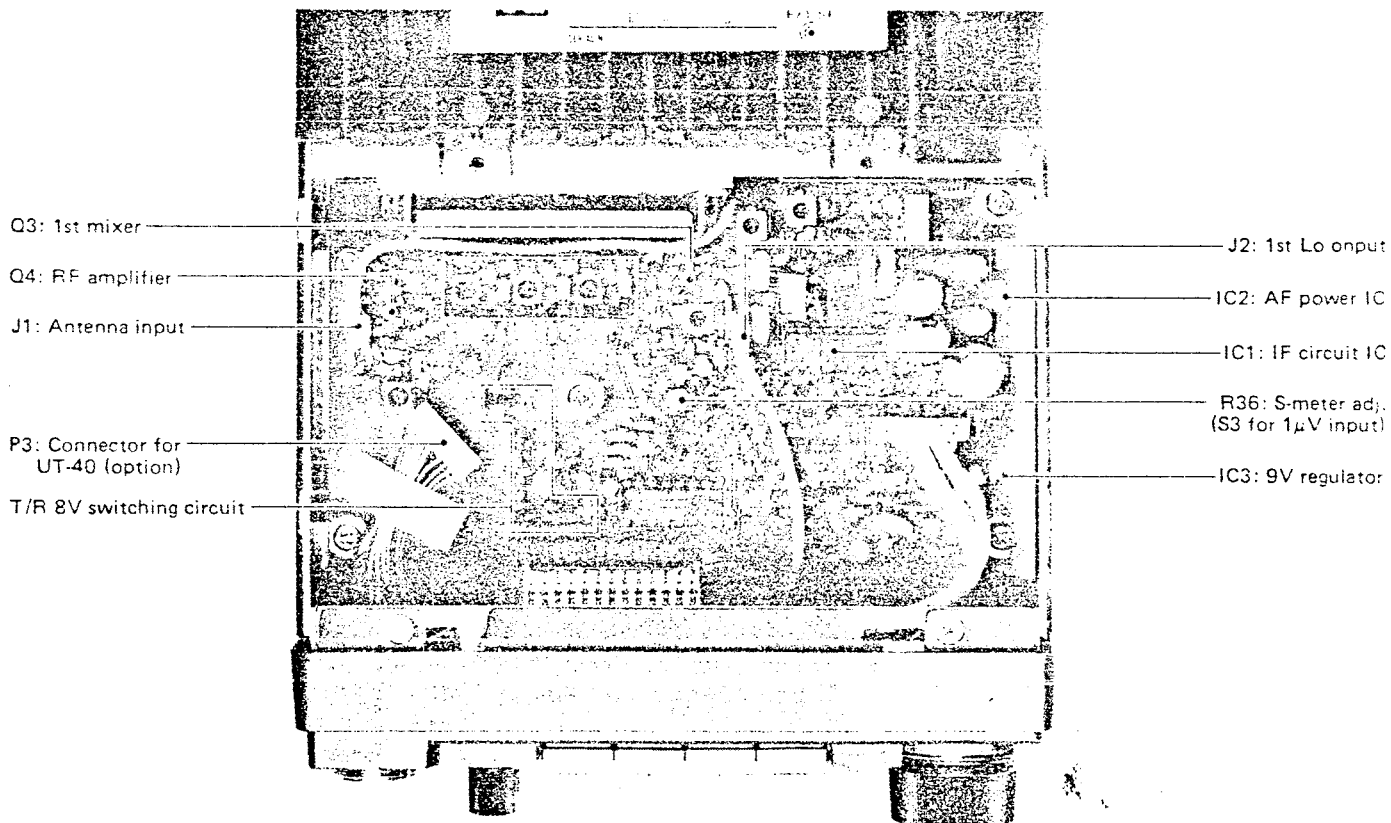
APPROVED	CHECKED	REPRESENTATIVE	REVISION	MODEL	PAGE No.
				FX-671	FX-671 -9A12

11. INSIDE VIEWS

■ TOP SIDE VIEW (MAIN UNIT)

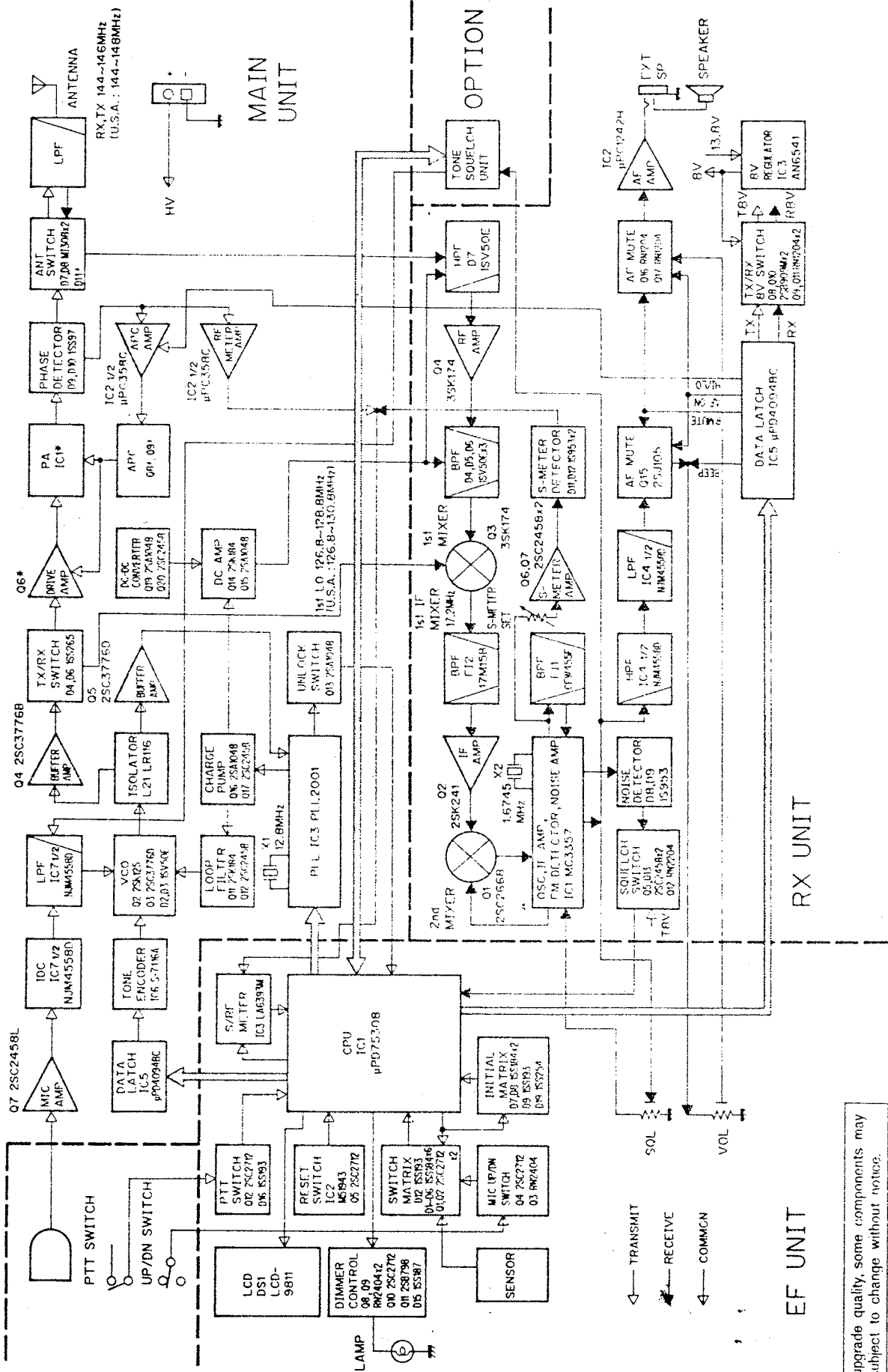


■ BOTTOM SIDE VIEW (RX UNIT)



Above photos show IC-228H U.S.A. version

MODEL	IC-1	O6	O8	O9	O11
IC-228A/E	SC-1019	2SC2407	2SA1359	2SC2458	MI308
IC-228H	SC-1022	TRF559	2SB1019	2SC1645	MI407



In upgrade quality, some components may be subject to change without notice.

13. SPECIFICATIONS

■ GENERAL

• Frequency coverage

MODEL	VERSION	RECEIVER	TRANSMITTER
IC-28A/H	U.S.A.	138.00 ~ 174.00MHz*	140.00 ~ 150.00MHz*
IC-28A/H	Australia	144.00 ~ 148.00MHz	144.00 ~ 146.00MHz
IC-28A/H	Asia	138.00 ~ 174.00MHz*	140.00 ~ 150.00MHz*
IC-28E/H	Europe	144.00 ~ 146.00MHz	144.00 ~ 146.00MHz
IC-28E/H	Italy	140.00 ~ 150.00MHz*	140.00 ~ 150.00MHz*

* Specifications apply to 144.00 ~ 148.00MHz only.

• Mode

: F3 (FM)

• Selectable tuning step (Initial)

: 5, 10, 15, 20 and 25kHz
(U.S.A. Australia, Asia versions)
12.5 and 25kHz
(Europe, Italy versions)

• Memory channels

: 20 plus a call channel

• Antenna impedance

: 50Ω

• Power supply requirement

: 13.8V DC ±15% (negative ground)

• Current drain (IC-228H)

: Receive 450mA (standby)
800mA (max. audio output)
Transmit 3.5A (LOW)
9.5A (HIGH)

• Current drain (IC-228A/E)

: Receive 450mA (standby)
800mA (max. audio output)
Transmit 3.0A (LOW)
6.0A (HIGH)

• Usable temperature range

: -10°C ~ +60°C

• Frequency stability

: ±10ppm (-10°C ~ +60°C)

• Dimension

: IC-228H 140mm(W) x 50mm(H) x 159mm(D)
IC-228A/E 140mm(W) x 50mm(H) x 137mm(D)
(Projections not included)

• Weight

: IC-228H 1.1kg; IC-228A/E 0.85kg

■ TRANSMITTER

• Output power

: IC-228H 45W (HIGH), 5W (LOW)
IC-228A/E 25W (HIGH), 5W (LOW)

• Modulation system

: Variable reactance frequency modulation

• Max. frequency deviation

: ±5kHz

• Spurious emissions

: Less than -60dB

• Microphone impedance

: 600Ω

■ RECEIVER

• Receiver system

: Double-conversion superheterodyne

• Intermediate frequency

: 1st 17.2MHz
2nd 455kHz

• Sensitivity

: 0.18μV for 12dB SINAD

• Selectivity

: More than 15kHz/-6dB
Less than 30kHz/-60dB

• Audio output power

: More than 2.4W at 10% distortion with an 8Ω load.

• Audio output impedance

: 8Ω



Icom America, Inc.
 2380 - 116th Ave. N.E.
 Bellevue, Washington 98004
 (206) 454-7619

SERVICE BULLETIN *Diw*

Unit Model: IC-228

SB # 13888-001 Effective Date: 5/17/88

Serial No. Affected: 1000-1100 (NOT ALL ARE AFFECTED)

Product Group: AMATEUR

Background Information:

IC-228 Some units are not maintaining programmed memories.

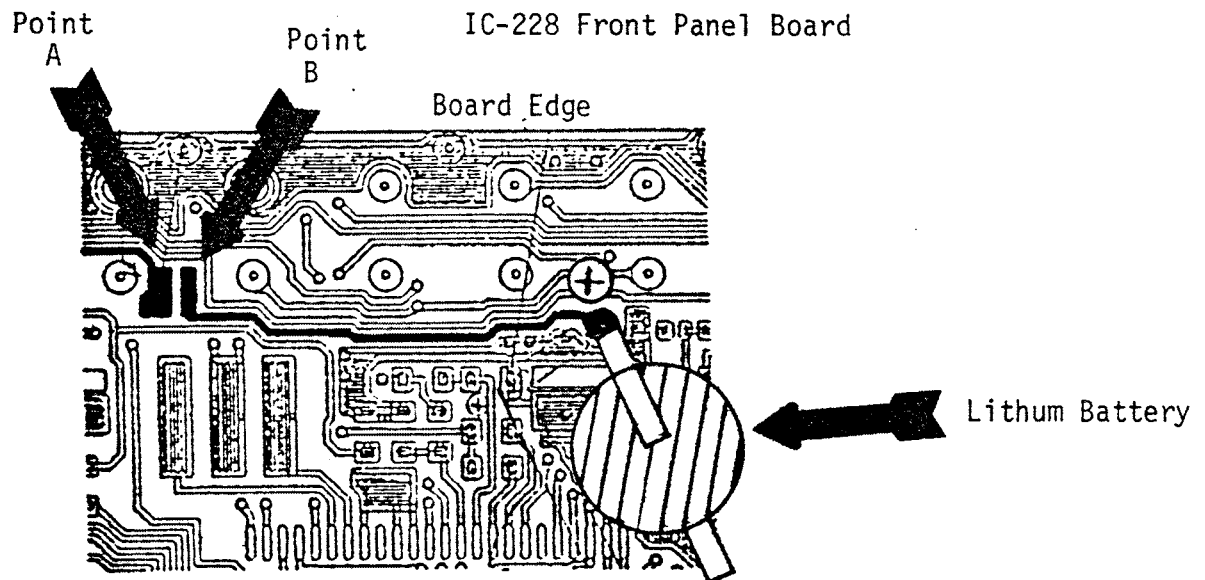
Technical Information:

There is a solder bridge that is missing to complete the lithium battery circuit, to maintain memories. The solder bridge needs to be made if not in place.

PROCEDURE:

1. Remove the top and bottom covers.
2. Remove front panel from main chassis of radio. Necessary to unplug J6 connector from the RX unit and connectors J1 and J2 from Main unit.
3. Locate solder pads for solder bridge, if not soldered, bridge between points A and B. See Figure 1 .
4. Replace front panel to main chassis of radio.
5. Replace top and bottom covers.

FIGURE 1



This Service Bulletin Consists of 1 pages total.

Estimated time to complete is 30 Minutes Maxium

Releases: Svc M.P. Eng Bill Mkt Eq

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INTER-COMPANY SERVICE FOLLOW UP / COMMENT

TO	EVERYONE	OFFICE	TRANSFER FROM
FROM	RUSSELL	OFFICE	MODEL # 2284 - A11 - S/N#
TAG #			DATE 8/30

Problem:

If you store a frequency into the CALL channel with a tone (179.0, don't know about others yet, need radio for further tests.) It will lock up the memory channels in that you can't write anymore memories. The radio will still work, but no access to MW. The tone does not matter if enabled or not, just in setup.

Russell

TECH. SIGNATURE _____

ICOM AMERICA, INC.
 Bellevue Service Facility
 2380 - 116 th Avenue N.E.
 Bellevue, Washington 98004



Icom America, Inc.
 2380 - 116th Ave. N.E.
 Bellevue, Washington 98004
 (206) 454-7619

SERVICE BULLETIN

Unit Model: IC-228 A/H SB # 13889-002 Effective Date: 5-1-89

Serial No. Affected: ALL Product Group: AMATEUR

Background Information:

Some users complain of "dampend" S-meter response at low ambient temperatures.

Technical Information:

Perform following modification of the S-meter circuit for improved response:

PART AFFECTED		BOARD TYPE	CHANGE TO	NEW PART NUMBER
R-33	15K/R20	RX	8.2K/R20	915-01112
C-8	120pf/50V	RX	39pf/50V	918-01643

Detailed Procedure:

1. Locate main board.
2. Replace affected components
3. Test unit at low temperature.
4. Replace covers and return to service.

This Service Bulletin Consists of 1 pages total. Estimated time to complete is 30 min.

Releases: Svc MA Eng ABE Mkt EG

THIS SERVICE BULLETIN IS TO PROVIDE INFORMATION ON CHANGES/IMPROVEMENTS TO EXISTING EQUIPMENT. ICOM ASSUMES NO LIABILITY OR RESPONSIBILITY FOR THE IMPROPER INSTALLATION OF THIS PROCEDURE.

ICOM TECHNICAL SUPPORT DEPT
Return This Material if This
Stamp is Printed Red.



144 MHz FM TRANSCEIVER

IC-281H

*Vol/SQL Flex Code
934-10775*

MASTER
Do Not Remove
From Tech Support Area

Icom Inc.

INTRODUCTION

This service manual describes the latest information for the **IC-281H** 144 MHz FM TRANSCEIVER at the time of publication.

VERSION NO.	VERSION	SYMBOL
#02	Europe	EUR
#03	Italy	ITA
#05	U.S.A.	USA
#06	Korea	KOR
#07	Australia	AUS
#08	Asia	SEA

DANGER

NEVER connect the transceiver to an AC outlet or to a DC power supply that uses more than 16 V. This will ruin the transceiver.

DO NOT expose the transceiver to rain, snow or any liquids.

DO NOT reverse the polarities of the power supply when connecting the transceiver.

DO NOT apply an RF signal of more than 20 dBm (100 mW) to the antenna connector. This could damage the transceiver's front end.



ORDERING PARTS

Be sure to include the following four points when ordering replacement parts:

1. 10-digit order numbers
2. Component part number and name
3. Equipment model name and unit name
4. Quantity required

<SAMPLE ORDER>

1110003460 IC LA4422 IC-281H MAIN UNIT 5 pieces
8810003100 Screw OH M2.6 x 5 ZK BS IC-281H Top cover 10 pieces

Addresses are provided on the inside back cover for your convenience.

REPAIR NOTES

1. Make sure a problem is internal before disassembling the transceiver.
2. **DO NOT** open the transceiver until the transceiver is disconnected from its power source.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits of electronic parts. An insulated tuning tool **MUST** be used for all adjustments.
5. **DO NOT** keep power ON for a long time when the transceiver is defective.
6. **DO NOT** transmit power into a signal generator or a sweep generator.
7. **ALWAYS** connect a 40 dB to 50 dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
8. **READ** the instructions of test equipment thoroughly before connecting equipment to the transceiver.

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To upgrade quality, all electrical or mechanical parts and internal circuits are subject to change without notice or obligation.

SECTION 1 SPECIFICATIONS

GENERAL

- Frequency coverage (MHz) :

Version	Frequency coverage (MHz)	
	VHF	UHF (Rx)
U.S.A.	144.00–148.00	440.00–450.00
Australia	144.00–148.00	430.00–440.00
Asia	144.00–148.00 (Rx: 136.00–174.00 ^{*1})	430.00–440.00
Korea	144.00–146.00	435.075–440.00
Europe	144.00–146.00	430.00–440.00
Italy	144.00–148.00 (Rx: 136.00–174.00 ^{*1})	400.00–479.00 ^{*2}

^{*1} Guaranteed 144–148; ^{*2} Guaranteed 430–440.

- Mode : FM (F3)
- Tuning step increments : 5, 10, 12.5, 20, 25, 30 or 50 kHz
- Number of memory channels : 60 regular, 2 call, 10 scratch pads and 12 scan edges
- Power supply requirement : 13.8 V DC \pm 15 % (negative ground)
- Current drain (at 13.8 V DC) :

Transmit	High	10.5 A
	Mid	5.5 A
	Low	4.0 A
Receive	Max. audio	1.0 A
	Stand by	0.8 A
- Antenna impedance : 50 Ω (nominal)
- Usable temperature range : -10°C to $+60^{\circ}\text{C}$ ($+14^{\circ}\text{F}$ to $+140^{\circ}\text{F}$)
- Frequency stability : \pm 10 ppm (-10°C to $+60^{\circ}\text{C}$)
- Dimensions : 140 (W) x 40 (H) x 171 (D) mm; 5.5 (W) x 1.6 (H) x 6.7 (D) in
(Projections not included)
- Weight : 930 g (2.1 lb)

TRANSMITTER

- Output power :

High	50 W
Mid	10 W
Low	5 W
- Modulation system : Variable reactance frequency modulation
- Microphone impedance : 600 Ω
- Max. frequency deviation : \pm 5.0 kHz
- Spurious emissions : Less than -60 dB

RECEIVER

- Receive system : Double-conversion superheterodyne
- Sensitivity :

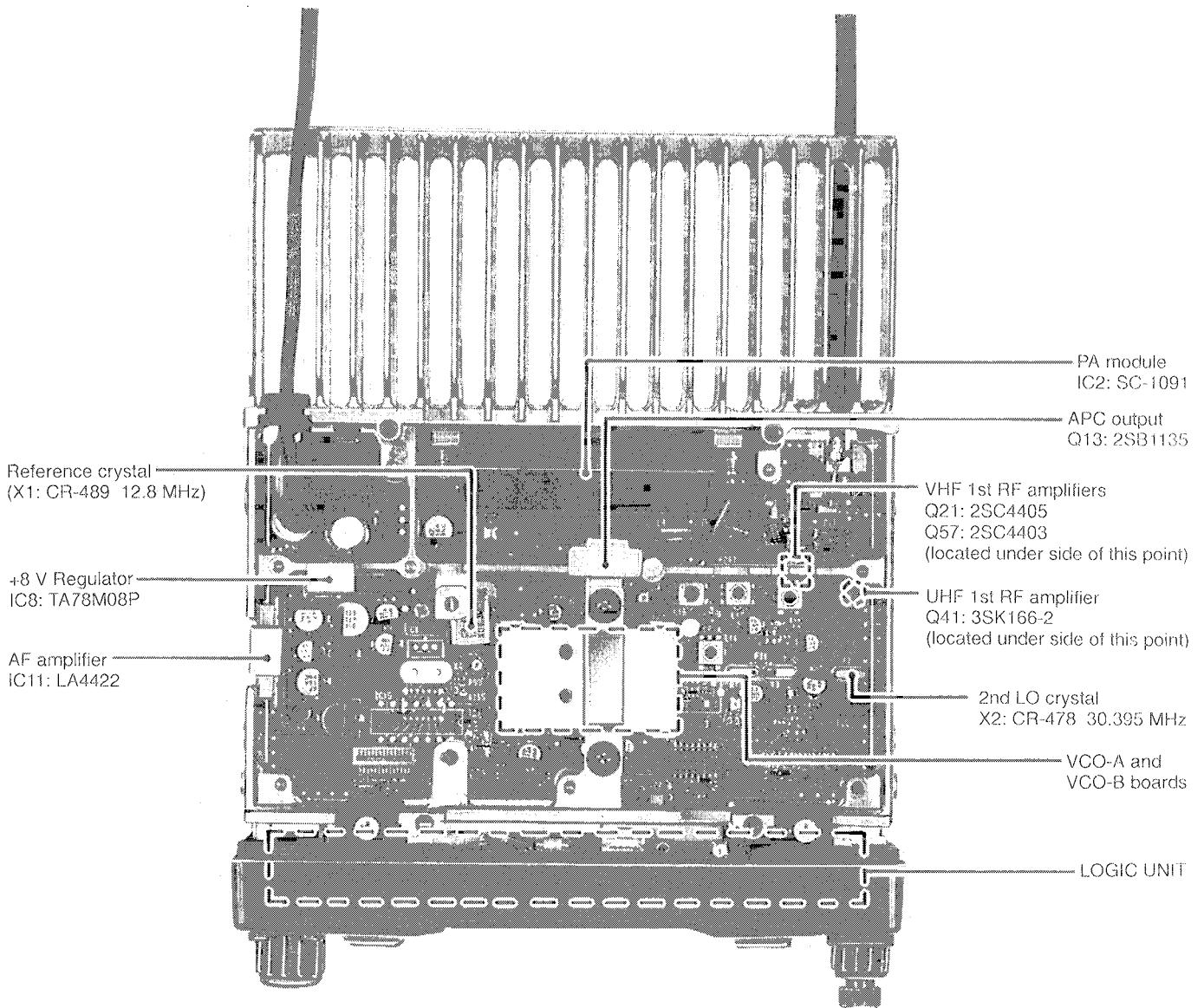
VHF	Less than 0.16 μV for 12 dB SINAD
UHF	Less than 0.2 μV for 12 dB SINAD
- Intermediate frequencies :

1st	30.85 MHz
2nd	455 kHz
- Squelch sensitivity (at threshold) : Less than 0.13 μV
- Spurious response rejection : More than 60 dB
- Audio output power : More than 2.4 W at 10% distortion with an 8 Ω load
- Audio output impedance : 4 to 8 Ω

All stated specifications are subject to change without notice or obligation.

SECTION 2 INSIDE VIEWS

• MAIN UNIT



SECTION 3 CIRCUIT DESCRIPTION

3-1 RECEIVER CIRCUITS

3-1-1 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

The antenna switching circuit functions as a low-pass filter while receiving and a resonator circuit while transmitting. The circuit does not allow transmit signals to enter receiver circuits.

VHF CIRCUIT

Received signals enter the antenna connector and then pass through the low-pass filter (L11, L12, C60, C61), the $\lambda/4$ type antenna switching circuit (D16, D17, L20, L21, C102, C264) and are then applied to the RF amplifier (Q21, Q57).

UHF CIRCUIT

Received signals pass through the high-pass filter (C189–C191, C265, C266, L37, L38) to suppress VHF band signals. The filtered signals are applied to the RF amplifier (Q41) through the antenna switching circuit (D27), low-pass filter circuit (L30, L31, C172–C174) and high-pass filter circuit (C169–C170, L29).

3-1-2 RF AND 1ST MIXER CIRCUITS

The 1st mixer circuit converts the received signal to a fixed frequency of the 1st IF signal with a PLL output frequency. By changing the PLL frequency, only the desired frequency will be passed through a pair of crystal filters at the next stage of the 1st mixer.

VHF CIRCUIT

The signals from the antenna switching circuit are passed through the tunable band-pass filter (D14, L19, C98) and amplified at the RF amplifier (Q21, Q57). The amplified signals are again passed through the tunable band-pass filter (L16, L17, D11, D12) and applied to the 1st mixer (Q19). The signals are then mixed with a 1st LO signal coming from the VCO-A board to produce a 30.85 MHz 1st IF signal. The 1st IF signal is passed through a pair of crystal filters (F11) and is then applied to the IF amplifier (Q18).

UHF CIRCUIT

UHF signals are amplified at the RF amplifier (Q41, IC6), and are mixed at the 1st mixer (Q40) with a 1st LO signal coming from the VCO-B board to produce a 30.85 MHz 1st IF signal.

3-1-3 2ND IF AND DEMODULATOR CIRCUITS

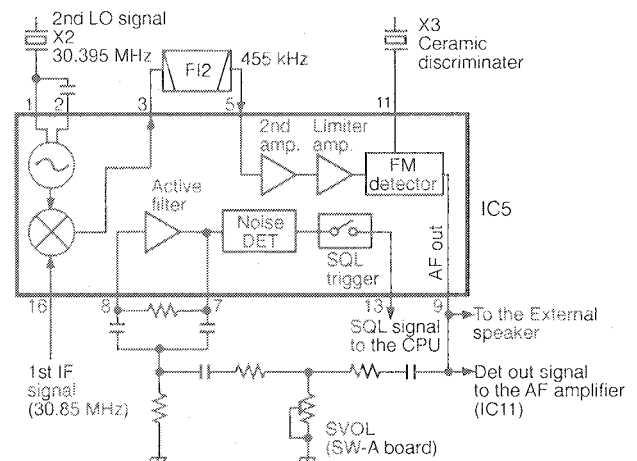
The 2nd mixer circuit converts the 1st IF signal to a 2nd IF signal. A double superheterodyne system (which converts

receive signal twice) improves the image rejection ratio and obtains stable receiver gain.

The 1st IF signal from the crystal filter (F11) is amplified at Q18 and applied to a 2nd mixer section of IC5 (pin 16). The signal is then mixed with a 2nd LO signal for conversion to a 455 kHz 2nd IF signal.

IC5 contains the 2nd mixer, local oscillator, limiter amplifier, quadrature detector, S-meter detector and active filter. The local oscillator section generates 30.395 MHz using X2. The 2nd IF signal from the 2nd mixer (IC5 pin 3) passes through ceramic filters (F12) to remove unwanted heterodyned frequencies and fix a passband width. It is then amplified at the limiter amplifier (IC5 pin 5) and applied to the quadrature detector (IC5 pins 9–11 and X3) to demodulate the 2nd IF signal into AF signals. The AF signals (detector signals) are output from pin 9.

FM DETECTOR AND SQUELCH CIRCUITS



3-1-4 AF CIRCUIT (MAIN UNIT)

The AF OUT signals from IC5 (pin 9) pass through the AF switch (Q31) and are amplified at the active filters (Q33 HPF; Q34 LPF). Those signals pass through the detector mute switch (Q38), and are adjusted with the volume control at the SW-A board.

The AF amplifier IC11 amplifies the signals to a sufficient level to drive the speaker. The AF mute switch (Q47) turns ON to cut the signal to be input to the AF amplifier (IC7) during transmission.

The AF OUT signals from the VR1 line are also amplified at the AF amplifier (LOGIC unit Q1) to output AF signal from the microphone connector.

3-1-5 SQUELCH CIRCUIT (MAIN and LOGIC UNITS)

A squelch circuit cuts out AF signals when no RF signals are being received. By detecting noise components in the AF signals, the squelch circuit turns the AF mute switch OFF.

A portion of the AF signals from the FM IF IC (IC5 pin 9) are applied to the active filter (IC5 pin 8) through the noise filter (C132, C133, R113, R114). The active filter section in IC5 amplifies noise components of frequencies of 20 kHz and above, and are rectified at the noise detector section in IC5 and then applied to the trigger section in IC5.

The trigger section in IC5 converts the rectified signals to a "High" or "Low" signal and applies this to the CPU (LOGIC unit IC6 pin 5) as the busy signal. When the CPU receives "High," the CPU outputs the mute signal through the I/O expander IC (MAIN unit IC13, pin 7) to cut the AF signals at the detector mute switch (Q38).

Even when the squelch is closed, the AF mute switch (Q47) is turned OFF to emit beep tones.

3-2 TRANSMITTER CIRCUITS

3-2-1 MICROPHONE AMPLIFIER (LOGIC UNIT)

The microphone amplifier circuit amplifies audio signals with +6 dB/octave pre-emphasis characteristics from the microphone to a level needed for the modulation circuit.

The AF signals from the microphone are amplified at the microphone amplifier (Q5) and the limiter amplifier (IC1a) which has a negative feedback circuit for +6 dB/octave pre-emphasis.

The amplified signals are applied to the splatter filter (IC1b) to filter out RF components and then applied to the VCO-A board (MAIN unit) as the "MOD" signal.

3-2-2 MODULATION CIRCUIT (VCO-A BOARD)

The modulation circuit modulates the VCO oscillating signal (RF signal) using the microphone audio signals.

The audio signals (MOD) change the reactance of D2 on the VCO-A board to modulate the oscillated signal at the transmitter VCO (Q1, Q2). The oscillated signal is amplified at the buffer amplifier (Q3, Q4, Q5), then applied to the drive amplifiers on the MAIN unit.

3-2-3 DRIVE/POWER AMPLIFIER CIRCUITS (MAIN UNIT)

The signal from the VCO-A board is passed through the transmit/receive switching circuit (D2) and amplified by the pre-driver (Q11), driver (Q12), and the power module (IC2) in sequence to obtain 50 W (at 13.8 V DC) of RF power. The amplified signal is passed through the antenna switching circuit (D7), APC detector circuit (L10, D8, D9), and low-pass filter (L11, L12, C60, C61) and is then applied to the antenna connector.

The collector current of the driver (Q12) are controlled by the APC circuit to protect the power module from a mismatched condition as well as to stabilize the output power.

3-2-4 APC CIRCUIT (MAIN UNIT)

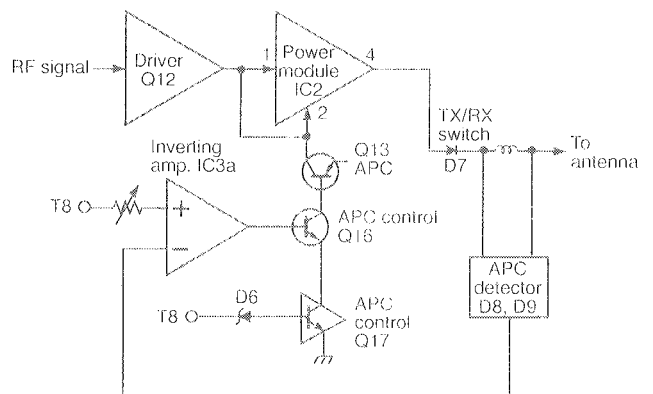
The APC circuit protects the power module (IC2) from a mismatched output load and selects High or Low output power.

The APC detector circuit (L10, D8, D9) detects forward signals and rectified signals at D8 and D9 respectively. The combined voltage is at a minimum level when the antenna is matched at 50 Ω and is increased when it is mismatched.

The detected voltage is applied to the inverting amplifier (IC3a) to control the collector of Q12 and bias voltage of IC2 (pin 2) using Q16 and Q17.

When the antenna impedance is mismatched, the input voltage of the inverting amplifier (IC3a) increases, and the base voltage of Q16 and the collector current of Q13 decreases to reduce the output power.

APC CIRCUIT



3-3 PLL CIRCUITS

A PLL circuit provides stable oscillation of the transmit frequency and the receive local frequency. The PLL circuit compares the phase of the divided VCO frequency to the reference frequency. The PLL output frequency is controlled by the divided ratio (N-data) of a programmable divider.

The PLL ICs (VHF: IC1, RX UHF: IC4) contains a prescaler, two programmable dividers, and a phase detector, etc.

The entered signal is divided at the prescaler and programmable counter sections by the N-data ratio from the CPU. The divided signals are detected on phase at the phase detector using the reference frequency (X1, Q1, Q2: 12.8 MHz).

If the oscillated signal drifts, the phase of its frequency changes from the reference frequency, causing a lock voltage change to compensate for the drift in the oscillated frequency.

VCO signals are amplified at the buffer amplifiers and are then applied to the receive 1st mixers (Q19 for VHF, Q40 for UHF) or transmitter circuit (Q1, Q12).

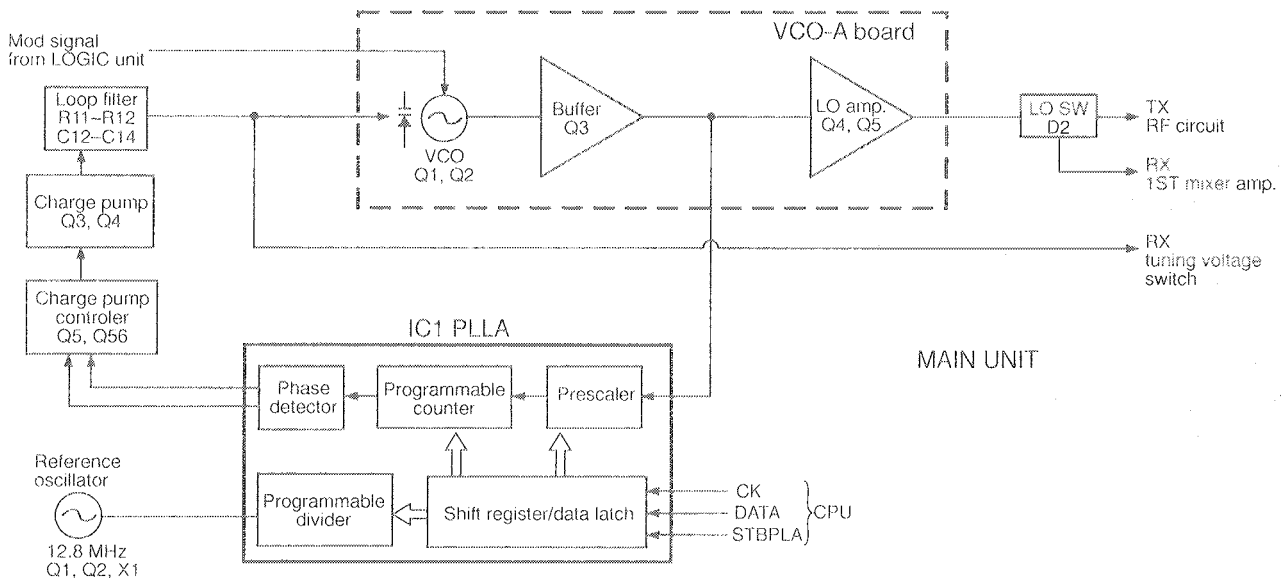
The lock voltage is also used for the receiver tunable band-pass filter of the VHF receiver circuit to match the filter's center frequency to the desired receive frequency. The lock voltage is amplified at the buffer amplifier Q8 and then applied to the tunable band-pass filter (D11, D12, D14).

3-4 POWER SUPPLY CIRCUITS

3-4-1 VOLTAGE LINES

13.8 V	13.8 V controlled by the power switch. When the power is turned ON, the "STBPLB" and "STBPLA" are pulled up, so that Q45 and Q46 in the MAIN unit are turned ON.
+9 V	Common +9 V is converted from 13.8 V line by the +9 V regulator (IC10), and is used for the charge pump.
+8 V	Common +8 V is converted from 13.8 V line by the +8 V regulator (IC8).
T 8 V	T 8 V is produced from +8 V at Q9 and Q10 on the MAIN unit. I/O expander (IC12 pin 4) controls Q9 and Q10.
R 8 B	Receive 8 V for the UHF receiver circuit. R8B is produced at Q52 and Q53 on the MAIN unit using a control signal, "3RX" from the I/O expander (IC12 pin 13).
R 8 M	Receive 8 V for the VHF receiver circuit. R8M is produced at Q48 and Q49 on the MAIN unit using a control signal "2RX" from the I/O expander (IC12 pin 14).
C 5 V	Common 8 V for the LOGIC unit and the [POWER] switch. C5 V is produced at IC14 on the MAIN unit from external DC input directly.
+5 V	Common +5 V is converted from 13.8 V line by the +5 V regulator (IC9).

VHF PLL CIRCUIT



3-5 PORT ALLOCATION

CPU (LOGIC UNIT IC6)

PIN NO.	PORT NAME	SIGNAL NAME	DESCRIPTION
2	AN0	UP/DOWN	Input ports for the channel selector from the microphone.
3	AN1	PTT	Input port for the [PTT] switch.
4	AN2	S/RF	Input port for the S/RF meter signal.
5	AN3	SQL	Input port for the noise squelch signal from the FM IF IC (MAIN unit IC5). When the squelch open: High
8 9	OSC1 OSC2	---	Terminals for the CPU clock.
10	RESET	RESET	Input port for the CPU reset signal.
11 12	X1 X2	---	Clock oscillator terminals for clock/timer function.
14 -- 16	D0 -- D2	STBI1 -- STBI3	Outputs a strobe signal for the initial matrix.
17, 18	D3, D4	STBK1, STBK2	Outputs a strobe signal for the key matrix.
19	D5	MONI SW	Input port for the monitor switch.
20	D6	SBUSY	Outputs a voice synthesizer control signal to activate an optional UT-36.
22	D8	STBSP	Outputs a strobe signal for an optional UT-36 voice synthesizer unit.
23	D9	UNLKA	Input port for the VHF PLL unlock signal. When PLL unlocked : High.
24	D10/ STOPC	UNLKB	Input port for the UHF PLL unlock signal. When PLL unlocked : High.
25	D11/INT0	PWRSW	Input port for the power switch.
26	R00/INT1	BACK UP	Input port for the backup signal to save data before power is turned OFF.
27 28 29	R01/INT2 R02/INT3 R03/INT4	DIALCK DIALUP DIALDN	Input ports for the channel selector from the dial selector.
30	R10/TOB	BEEP	Outputs a beep tone signal.
31	R11/TOC	STONE	Outputs a 88.5 Hz tone signal
32 33	R12/TOD R13/EVNB	DIM0 DIM1	Outputs LCD backlight intensity signals.
34	R20/EVND	STBCO	Outputs a strobe signal for the I/O expander ICs (MAIN unit, IC12, IC13).
35	R21/SCK	CK	Outputs a serial clock signal.
36	R22/SI	SIN	Input port for the DTMF data.
37	R23/SO	DATA	Outputs serial data.
38	R30/SEG1	STBPLA	Outputs a strobe signal to the VHF PLL IC (MAIN unit IC1).
39	R31/SEG2	STBPLB	Outputs a strobe signal to the UHF PLL IC (MAIN unit IC4).
40	R32/SEG3	STBTO	Outputs a strobe signal for a tone encoder and a tone squelch.

PIN NO.	PORT NAME	SIGNAL NAME	DESCRIPTION
41	R33/SEG4	P/S OPT	Outputs a DTMF encoder power control signal.
42 -- 45	R40/SEG5 -- R43/SEG8	KEY10 -- KEY13	Input ports for the initial matrix and key matrix.
46 -- 89 90, 91	SEG9 -- SEG52 COM1, COM2	LP46 -- LP3 LP1, LP2	Outputs the LCD drive signal.
98 99	TONEC TONER	DTMFC DTMFR	Outputs DTMF row and column signals.

SECTION 4 ADJUSTMENT PROCEDURES

4-1 PLL ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
LOCK VOLTAGE	<ul style="list-style-type: none"> ● Displayed frequency: 145.000 MHz ● Receiving 	MAIN	Connect the DC voltmeter to CP-A.	2.0 V	VCO-A	L2
REFERENCE FREQUENCY	1 <ul style="list-style-type: none"> ● Displayed frequency: 145.000 MHz ● Connect the RF power meter or a 50 Ω dummy load to the antenna connector ● Transmitting 	MAIN	Loosely couple the frequency counter to the antenna connector.	145.000 MHz	MAIN	C1

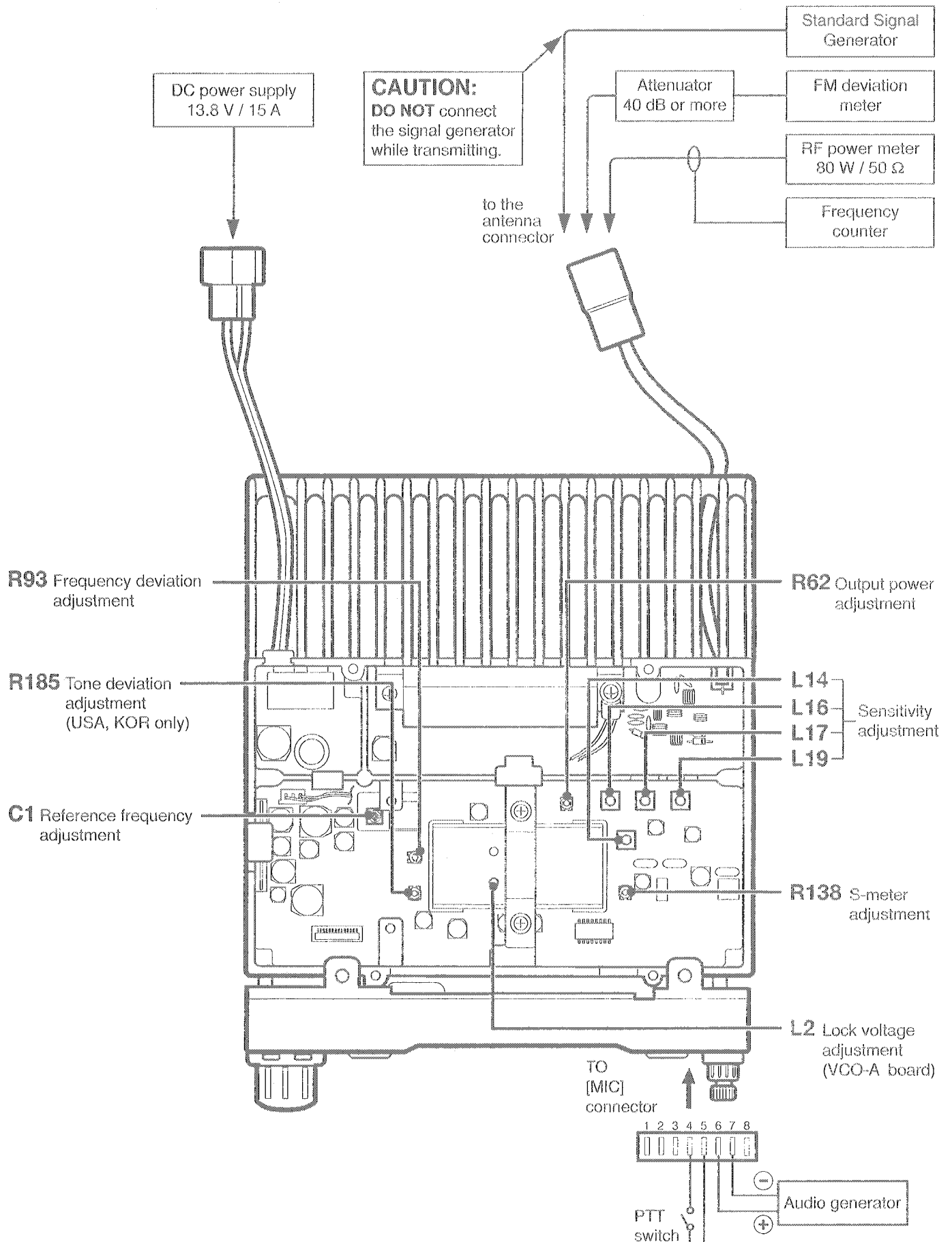
4-2 RECEIVER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
SENSITIVITY	1 <ul style="list-style-type: none"> ● Displayed frequency: Center of each band ● [SQL] control : Max. CCW ● [R138] : Max. CW ● Connect the SSG to the antenna connector and set as: <ul style="list-style-type: none"> Level : 1.0 μV* (-107 dBm) Modulation : 1 kHz Deviation : \pm7 kHz ● Receiving 	MAIN	Connect the DC voltmeter to CP-B.	Maximum DC voltage	MAIN	Adjust in sequence L19, L17, L16, L14
S-METER	1 <ul style="list-style-type: none"> ● Displayed frequency: Center of each band ● Connect the SSG to the antenna connector and set as: <ul style="list-style-type: none"> Level : 1.0 μV* (-107 dBm) Modulation : 1 kHz Deviation : \pm3.5 kHz ● Receiving 	Front panel	LCD display	S3 (4 dots)	MAIN	R138

* This output level of the standard signal generator (SSG) is indicated as the SSG's open circuit.

4-3 TRANSMITTER ADJUSTMENT

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1 <ul style="list-style-type: none"> ● Displayed frequency: Center of each band ● Output power: High ● Transmitting ● Be sure the power supply voltage is 13.8 V 	MAIN	Connect the RF power meter to the antenna connector.	50 W	MAIN	R62
	2 <ul style="list-style-type: none"> ● Output power: Low2 			8 W-15 W		Verify
	3 <ul style="list-style-type: none"> ● Output power: Low1 			3.5 W-7.5 W		
FREQUENCY DEVIATION	1 <ul style="list-style-type: none"> ● Displayed frequency: Center of each band ● Connect the audio generator to the [MIC] connector and set as: <ul style="list-style-type: none"> 20 mV/1.0 kHz ● Set the FM deviation meter as: <ul style="list-style-type: none"> HPF : 50 Hz LPF : 20 kHz De-emphasis : OFF Detector : (P-P)/2 ● Transmitting 	MAIN	Connect the FM deviation meter to the antenna connector through the attenuator.	\pm 4.8 kHz	MAIN	R93
TONE DEVIATION (USA, KOR only)	<ul style="list-style-type: none"> ● Displayed frequency: Center of each band ● Apply no signal to the microphone connector. ● Set the tone frequency as: 88.5 Hz ● Set the FM deviation meter as: <ul style="list-style-type: none"> HPF : 50 Hz LPF : 20 kHz De-emphasis : OFF Detector : (P-P)/2 ● Transmitting 	MAIN	Connect the FM deviation meter to the antenna connector through the attenuator.	\pm 0.8 kHz	MAIN	R185



SECTION 5 PARTS LIST

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1110000960	S.IC	NJM4558M(T1)
IC2	1130004670	S.IC	BU4021BF-T1
IC3	1130004330	S.IC	LC7385M
IC4	1110003240	S.IC	S-80740SL-A4-T1
IC5	1130003920	S.IC	TC4S69F (TE85R)
IC6	1140004210	S.IC	HD404629B32H
IC7	1130003760	S.IC	TC4S81F (TE85R)
Q1	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q2	1590001390	S.FET	2SJ144-Y (TE85R)
Q3	1590001390	S.FET	2SJ144-Y (TE85R)
Q4	1590000430	S.TRANSISTOR	DTC144EU T107
Q5	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q7	1590001390	S.FET	2SJ144-Y (TE85R)
Q8	1590000430	S.TRANSISTOR	DTC144EU T107
Q9	1590001390	S.FET	2SJ144-Y (TE85R)
Q10	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q11	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q12	1590001390	S.FET	2SJ144-Y (TE85R)
Q13	1590001390	S.FET	2SJ144-Y (TE85R)
Q14	1590000430	S.TRANSISTOR	DTC144EU T107
Q15	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q16	1590000430	S.TRANSISTOR	DTC144EU T107
Q17	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q18	1510000880	S.TRANSISTOR	2SA1622-6-TR
Q19	1530002840	S.TRANSISTOR	2SC4116-Y (TE85R)
Q20	1520000650	S.TRANSISTOR	2SB1201-S-TR
Q21	1530002840	S.TRANSISTOR	2SC4116-Y (TE85R)
Q22	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q23	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q24	1590001390	S.FET	2SJ144-Y (TE85R)
D1	1790001000	S.ZENER	MA8062-L(TX)
D2	1750000260	S.DIODE	1SS352 (TPH3)
D3	1750000260	S.DIODE	1SS352 (TPH3)
D4	1750000270	S.DIODE	1SS301 (TE85R)
D5	1750000270	S.DIODE	1SS301 (TE85R)
D6	1750000270	S.DIODE	1SS301 (TE85R)
D7	1750000270	S.DIODE	1SS301 (TE85R)
D8	1750000270	S.DIODE	1SS301 (TE85R)
D9	1750000260	S.DIODE	1SS352 (TPH3) (EUR, USA)
D10	1750000260	S.DIODE	1SS352 (TPH3) (EUR, ITA, USA, SEA)
D11	1750000260	S.DIODE	1SS352 (TPH3) (EUR, USA, SEA)
D12	1750000260	S.DIODE	1SS352 (TPH3) (EUR, ITA, USA, SEA)
D13	1750000260	S.DIODE	1SS352 (TPH3) (EUR, USA, AUS, SEA)
D14	1750000260	S.DIODE	1SS352 (TPH3) (EUR, AUS)
D15	1750000260	S.DIODE	1SS352 (TPH3)
D16	1750000260	S.DIODE	1SS352 (TPH3) (EUR, ITA, USA, SEA)
D17	1750000260	S.DIODE	1SS352 (TPH3) (KOR, AUS, SEA)
D18	1750000260	S.DIODE	1SS352 (TPH3) (KOR)
D19	1750000260	S.DIODE	1SS352 (TPH3) (EUR, ITA, KOR)
X1	6050006020	XTAL	CR-288
X2	6060000520	S.CERAMIC	CSAC2.00MGC200-TC
X3	6050005801	XTAL	DS-VT200 (32.768kHz)

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R1	7030003200	S.RESISTOR	ERJ3GEYJ 100 V (10 Ω)
R2	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R3	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R4	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R5	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R6	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R7	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R8	7030003420	S.RESISTOR	ERJ3GEYJ 681 V (680 Ω)
R9	7030003530	S.RESISTOR	ERJ3GEYJ 592 V (5.6 kΩ)
R10	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R11	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R12	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R13	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R14	7030003410	S.RESISTOR	ERJ3GEYJ 561 V (560 Ω)
R15	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R16	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R17	7030003310	S.RESISTOR	ERJ3GEYJ 820 V (82 Ω)
R18	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R19	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R22	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R24	7030003390	S.RESISTOR	ERJ3GEYJ 391 V (390 Ω)
R25	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R26	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 kΩ)
R27	7030003730	S.RESISTOR	ERJ3GEYJ 274 V (270 kΩ)
R28	7030003790	S.RESISTOR	ERJ3GEYJ 824 V (820 kΩ)
R29	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R30	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R31	7030003710	S.RESISTOR	ERJ3GEYJ 184 V (180 kΩ)
R32	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 kΩ)
R33	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R34	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 kΩ)
R35	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R36	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 kΩ)
R37	7030003670	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
R38	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R39	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 kΩ)
R40	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 kΩ)
R41	7030003870	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
R42	7030003670	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
R43	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R44	7030003670	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
R45	7030003540	S.RESISTOR	ERJ3GEYJ 682 V (6.8 kΩ)
R46	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R47	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R48	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R49	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 kΩ)
R50	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R51	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R52	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R53	7030003740	S.RESISTOR	ERJ3GEYJ 334 V (330 kΩ)
R54	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R55	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R56	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R57	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R58	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R59	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R60	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R61	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R62	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R63	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R64	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R65	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R67	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R68	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R69	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R70	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 kΩ)
R71	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R72	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R73	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R74	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)

S.—Surface mount

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R75	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R76	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R77	7310003560	S.TRIMMER	RV-220 (RH03AVALJ) 223
R78	7030003840	S.RESISTOR	ERJ3GEYJ 225 V (2.2 MΩ)
R79	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R80	7030003840	S.RESISTOR	ERJ3GEYJ 225 V (2.2 MΩ)
R81	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R82	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R83	7030000180	S.RESISTOR	MCR10EZHZ 22 Ω (220)
R84	7030000060	S.RESISTOR	MCR10EZHZ 2.2 Ω (2R2)
R85	7030000060	S.RESISTOR	MCR10EZHZ 2.2 Ω (2R2)
R86	7030000180	S.RESISTOR	MCR10EZHZ 22 Ω (220)
R87	7030001170	S.RESISTOR	MCR50JZHZ 220 Ω (221)
R88	7030003490	S.RESISTOR	ERJ3GEYJ 272 V (2.7 kΩ)
R89	7030003450	S.RESISTOR	ERJ3GEYJ 122 V (1.2 kΩ)
R90	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R91	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R92	7030003650	S.RESISTOR	ERJ3GEYJ 563 V (56 kΩ)
R93	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R95	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R96	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R97	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R98	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R99	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R100	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R102	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R103	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R104	7030003740	S.RESISTOR	ERJ3GEYJ 334 V (330 kΩ)
R105	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R106	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 kΩ)
R107	7030003500	S.RESISTOR	ERJ3GEYJ 332 V (3.3 kΩ)
R108	7030003500	S.RESISTOR	ERJ3GEYJ 332 V (3.3 kΩ)
R109	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 kΩ)
R110	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R111	7030003740	S.RESISTOR	ERJ3GEYJ 334 V (330 kΩ)
R112	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ) (EUR, ITA, KOR, AUS, SEA)
R113	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ) (EUR, ITA, KOR, AUS, SEA)
R114	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R115	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R116	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R117	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R118	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R119	7030003580	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R120	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R121	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R122	7030003670	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
R123	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R124	7030003670	S.RESISTOR	ERJ3GEYJ 823 V (82 kΩ)
C1	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C2	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C3	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C5	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C6	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C7	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C8	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C9	4510005300	S.ELECTROLITIC	ECEV1AA330P
C10	4030008680	S.CERAMIC	C2012 JF 1C 105Z-T-A
C11	4030008680	S.CERAMIC	C2012 JF 1C 105Z-T-A
C12	4510005600	S.ELECTROLITIC	ECEV1CS100SR
C13	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C14	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C15	4030006860	S.CERAMIC	C1608 JF 1C 104Z-T-A
C16	4510005600	S.ELECTROLITIC	ECEV1CS100SR
C17	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C18	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C19	4030008660	S.CERAMIC	C2012 JB 1H 333K-T-A
C20	4550000460	S.TANTALUM	TESVA 1C 105M1-8L
C21	4030008680	S.CERAMIC	C2012 JF 1C 105Z-T-A
C22	4030007020	S.CERAMIC	C1608 CH 1H 120J-T-A
C23	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C24	4030008680	S.CERAMIC	C2012 JF 1C 105Z-T-A
C25	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C26	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C27	4030009490	S.CERAMIC	C1608 JB 1H 821K-T-A
C28	4030008650	S.CERAMIC	C1608 JB 1H 332K-T-A
C29	4030008740	S.CERAMIC	C1608 SL 1H 820J-T-A
C30	4030008750	S.CERAMIC	C1608 SL 1H 101J-T-A
C31	4030008680	S.CERAMIC	C2012 JF 1C 105Z-T-A
C32	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C33	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C34	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C35	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C36	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C37	4550002950	S.TANTALUM	TESVA 0J 335M1-8L
C38	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C39	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C40	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C41	4030007080	S.CERAMIC	C1608 CH 1H 390J-T-A
C42	4030007070	S.CERAMIC	C1608 CH 1H 330J-T-A
C43	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C44	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C45	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C46	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C47	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C48	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C49	4030007090	S.CERAMIC	C1608 CH 1H 470J-T-A
C50	4030007100	S.CERAMIC	C1608 CH 1H 580J-T-A
C51	4030007030	S.CERAMIC	C1608 CH 1H 150J-T-A
C52	4030007030	S.CERAMIC	C1608 CH 1H 150J-T-A
C53	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C54	4030008870	S.CERAMIC	C1608 JB 1H 222K-T-A
C55	4030005110	S.CERAMIC	C2012 JB 1E 473K-T-A
C56	4030005110	S.CERAMIC	C2012 JB 1E 473K-T-A
C57	4030005090	S.CERAMIC	C2012 JB 1H 223K-T-A
C58	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C59	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C60	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C61	4030008760	S.CERAMIC	C2012 X7R 1C 104K-T-A
C62	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C63	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C64	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C65	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C66	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C67	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C68	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C69	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C70	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C71	4030008710	S.CERAMIC	C1608 SL 1H 470J-T-A
C72	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C73	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C74	4030006710	S.CERAMIC	C1608 SL 1H 470J-T-A
C75	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C76	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C77	4030008710	S.CERAMIC	C1608 SL 1H 470J-T-A
C78	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C79	4030008710	S.CERAMIC	C1608 SL 1H 470J-T-A
C80	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C81	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C82	4030008630	S.CERAMIC	C2012 JF 1C 105Z-T-A
C83	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C84	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
BT1	3020000210	LITHIUM	BR2032-1F2
DS1	5080000330	LAMP	HRS-7219A-RE
DS2	5080000330	LAMP	HRS-7219A-RE
DS3	5080000330	LAMP	HRS-7219A-RE
DS4	5080000330	LAMP	HRS-7219A-RE
DS5	5030001050	LCD	FTD-12578AAH
W3	7030003860	S.JUMPER	ERJ3GE JPW V
W4	7030003860	S.JUMPER	ERJ3GE JPW V
W5	7030003860	S.JUMPER	ERJ3GE JPW V
W6	7030003860	S.JUMPER	ERJ3GE JPW V
W7	7120000386	JUMPER	JPW 01 R-01

S.=Surface mount

[LOGIC UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
W8	7120000380	JUMPER	JPW 01 R-01
W9	7030003860	S.JUMPER	ERJ3GE JPW V
W10	7030000010	S.JUMPER	MCR10EZHJ JPW (000)
J1	6450001470	CONNECTOR	95003-2881
J2	6510012690	CONNECTOR	53020-0810
J3	6510012670	CONNECTOR	52022-3010
J4	6510016160	S.CONNECTOR	52465-1090
J5	6510016160	S.CONNECTOR	52465-1090
S1	2260001890	S.SWITCH	SKQDPA [LOW]
S2	2260001890	S.SWITCH	SKQDPA [SET-LOCK]
S3	2260001890	S.SWITCH	SKQDPA [DTMF]
S4	2260001890	S.SWITCH	SKQDPA [SPCH-MW]
S5	2260001890	S.SWITCH	SKQDPA [V/MHz]
S6	2260001890	S.SWITCH	SKQDPA [M/CALL]
S7	2260001890	S.SWITCH	SKQDPA [BAND]
S8	2260001890	S.SWITCH	SKQDPA [DUP]
EP1	0910041072	PCB	B 4066B
EP4	8930031680	LCD CONTACT	SRCN-1346W

[SW-A BOARD]

915-09852

REF. NO.	ORDER NO.	DESCRIPTION	
R1	7210002380	VARIABLE	TP96D00A-10KB10KA20F (1481) [VOL · SQL]
J1	6510016090	S.CONNECTOR	53309-1090 <i>936-10309</i>
EP1	0910041041	PCB	B 4120A <i>984-10775</i>

[SW-B BOARD]

REF. NO.	ORDER NO.	DESCRIPTION	
J1	6510016090	S.CONNECTOR	53309-1090
S1	2250000160	ENCODER	TP90N00AE20-15F (1352) [TUNING DIAL]
EP1	0910041052	PCB	B 4121B

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC1	1130005700	S.IC	M56760FP
IC2	1150000760	IC	SC1091
IC3	1110003340	S.IC	μPC358GR-T1
IC4	1130005700	S.IC	M56760FP
IC5	1110003200	S.IC	TA31136FN(EL)
IC6	1110001971	S.IC	μPC1676G-T1
IC7	1110001971	S.IC	μPC1676G-T1
IC8	1180001190	IC	TA78M08P
IC9	1180000420	S.IC	TA78L05F (TE12R)
IC10	1180001200	S.IC	LA5009M-TP-T1
IC11	1110003460	IC	LA4422
IC12	1130005810	S.IC	BU4094BF-T1
IC13	1130005810	S.IC	BU4094BF-T1
IC14	1180000420	S.IC	TA78L05F (TE12R)
IC15	1130000950	IC	S-7116A (USA, KOR)
IC16	1130005810	S.IC	BU4094BF-T1 (USA, KOR)
IC17	1130003920	S.IC	TC4569F (TE85R)

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
IC18	1130003710	S.IC	TC4571F (TE85R)
Q1	1530002560	S.TRANSISTOR	2SC4403-3-TR
Q2	1530002560	S.TRANSISTOR	2SC4403-3-TR
Q3	1530003010	S.TRANSISTOR	2SC4117-GR (TE85R)
Q4	1530003010	S.TRANSISTOR	2SC4117-GR (TE85R)
Q5	1560000530	S.FET	2SK880-GR (TE85R)
Q6	1530002840	S.TRANSISTOR	2SC4116-Y (TE85R)
Q7	1590001540	S.TRANSISTOR	UMD6 TL
Q8	1560000530	S.FET	2SK880-GR (TE85R)
Q9	1510000690	S.TRANSISTOR	2SA1734 (TE12R)
Q10	1590000430	S.TRANSISTOR	DTC144EU T107
Q11	1530002340	S.TRANSISTOR	2SC2954-T2B
Q12	1530002340	S.TRANSISTOR	2SC2954-T2B
Q13	1520000390	TRANSISTOR	2SB1135 R
Q14	1590000430	S.TRANSISTOR	DTC144EU T107
Q15	1590000430	S.TRANSISTOR	DTC144EU T107
Q16	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q17	1590000430	S.TRANSISTOR	DTC144EU T107
Q18	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q19	1580000480	S.FET	3SK184-S (TX)
Q20	1590000430	S.TRANSISTOR	DTC144EU T107
Q21	1530002570	S.TRANSISTOR	2SC4405-3-TR
Q22	1530002940	S.TRANSISTOR	2SC4228-T2 R44
Q23	1590000660	S.TRANSISTOR	DTC144TU T107
Q24	1530003010	S.TRANSISTOR	2SC4117-GR (TE85R)
Q25	1530003010	S.TRANSISTOR	2SC4117-GR (TE85R)
Q26	1530003010	S.TRANSISTOR	2SC4117-GR (TE85R)
Q27	1530002840	S.TRANSISTOR	2SC4116-Y (TE85R)
Q28	1590001540	S.TRANSISTOR	UMD6 TL
Q29	1560000530	S.FET	2SK880-GR (TE85R)
Q30	1590001390	S.FET	2SJ144-Y (TE85R)
Q31	1590001390	S.FET	2SJ144-Y (TE85R)
Q32	1590000430	S.TRANSISTOR	DTC144EU T107
Q33	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q34	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q35	1590000430	S.TRANSISTOR	DTC144EU T107
Q36	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q38	1590001390	S.FET	2SJ144-Y (TE85R)
Q39	1590000430	S.TRANSISTOR	DTC144EU T107
Q40	1580000480	S.FET	3SK184-S (TX)
Q41	1580000490	S.FET	3SK166-2-T7
Q42	1590000430	S.TRANSISTOR	DTC144EU T107
Q43	1560000480	S.FET	3SK184-S (TX)
Q44	1530002940	S.TRANSISTOR	2SC4228-T2 R44
Q45	1530002970	S.TRANSISTOR	2SC4684 (TE16R)
Q46	1590001540	S.TRANSISTOR	UMD6 TL
Q47	1530003090	S.TRANSISTOR	2SC4213-B (TE85R)
Q48	1590001040	S.TRANSISTOR	DTA113ZU T107
Q49	1590000430	S.TRANSISTOR	DTC144EU T107
Q50	1590001040	S.TRANSISTOR	DTA113ZU T107
Q51	1590000430	S.TRANSISTOR	DTC144EU T107
Q52	1590001040	S.TRANSISTOR	DTA113ZU T107
Q53	1590000430	S.TRANSISTOR	DTC144EU T107
Q54	1590001040	S.TRANSISTOR	DTA113ZU T107
Q55	1590000430	S.TRANSISTOR	DTC144EU T107
Q56	1560000530	S.FET	2SK880-GR (TE85R)
Q57	1530002560	S.TRANSISTOR	2SC4403-3-TR
Q58	1560000530	S.FET	2SK880-GR (TE85R)
Q59	1590001390	S.FET	2SJ144-Y (TE85R)
Q60	1590001540	S.TRANSISTOR	UMD6 TL
Q61	1590001540	S.TRANSISTOR	UMD6 TL
D1	1750000260	S.DIODE	1SS352 (TPH3)
D2	1790000450	S.DIODE	MA882(TX)
D3	1750000260	S.DIODE	1SS352 (TPH3)
D4	1790000860	S.DIODE	MA133(TX)
D5	1750000260	S.DIODE	1SS352 (TPH3)
D6	1790001010	S.ZENER	MA8043-L(TX)
D7	1710000310	DIODE	MI407
D8	1790000980	S.DIODE	MA742(TX)
D9	1790000980	S.DIODE	MA742(TX)
D10	1790000620	S.DIODE	MA77(TW)
D11	1720000370	S.VARICAP	HVU350TRF

S.=Surface mount

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
D12	1720000370	S.VARICAP	HVU350TRF
D13	1790000620	S.DIODE	MA77(TW)
D14	1720000370	S.VARICAP	HVU350TRF
D15	1790000620	S.DIODE	MA77(TW)
D16	1710000290	DIODE	MI308
D17	1710000290	DIODE	MI308
D18	1790000450	S.DIODE	MA862(TX)
D19	1750000260	S.DIODE	1SS352 (TPH3)
D20	1790001010	S.ZENER	MA8043-L(TX)
D21	1790000980	S.DIODE	MA742(TX)
D23	1160000060	S.DIODE	DAN202U T107
D24	1160000060	S.DIODE	DAN202U T107
D25	1790001010	S.ZENER	MA8043-L(TX)
D26	1790001010	S.ZENER	MA8043-L(TX)
D27	1790000450	S.DIODE	MA862(TX)
D28	1790000700	DIODE	DSA3A1
D29	1160000060	S.DIODE	DAN202U T107
D30	1160000060	S.DIODE	DAN202U T107
D31	1750000260	S.DIODE	1SS352 (TPH3)
D32	1750000260	S.DIODE	1SS352 (TPH3)
D33	1790000980	S.DIODE	MA742(TX)
D34	1750000260	S.DIODE	1SS352 (TPH3)
D35	1750000260	S.DIODE	1SS352 (TPH3)
D36	1750000260	S.DIODE	1SS352 (TPH3)
FI1	2010001610	MONOLITHIC	FL-202 UM-5 30.850MHz
FI2	2020000550	CERAMIC	CFUM455E
X1	6050009090	XTAL	CR-489 (12.800MHz)
X2	6050008950	XTAL	CR-478 UM-1 30.395MHz
X3	6070000130	DISCRIMINATOR	CDBM455C24
X4	6050003120	XTAL	RF-4A3 FAA NKD (3.579545M) (USA. KOR)
L1	6200001570	S.COIL	LER 015T 1R0M
L2	6200002420	S.COIL	NL 252018T-068J
L3	6200002580	S.COIL	NL 252018T-033J
L4	6200002420	S.COIL	NL 252018T-068J
L5	6200002580	S.COIL	NL 252018T-033J
L6	6200002420	S.COIL	NL 252018T-068J
L7	6200002420	S.COIL	NL 252018T-068J
L8	6170000180	COIL	LW-19
L9	6110001600	COIL	LA-243
L10	6110001550	COIL	LA-235
L11	6110001560	COIL	LA-236
L12	6110001600	COIL	LA-243
L13	6200003510	S.COIL	LER015T R82M
L14	6150003210	COIL	LS-319
L15	6200002640	S.COIL	NL 252018T-R15J
L16	6150003430	COIL	LS-378
L17	6150003120	COIL	LS-321
L19	6150003120	COIL	LS-321
L20	6110001560	COIL	LA-236
L21	6110001570	COIL	LA-237
L22	6200002740	S.COIL	LL2012-F6N8K
L23	6200003390	S.COIL	LL2012-F12NK
L24	6200001570	S.COIL	LER 015T 1R0M
L25	6200002090	S.COIL	ELJFB 681K-F
L26	6200003560	S.COIL	NL 252018T-018J
L27	6200003390	S.COIL	LL2012-F12NK
L28	6200002580	S.COIL	NL 252018T-033J
L29	6200003880	S.COIL	NL 252018T-022J
L30	6200003860	S.COIL	NL 252018T-010J
L31	6200003530	S.COIL	NL 252018T-012J
L32	6200002740	S.COIL	LL2012-F6N8K
L33	6200003460	S.COIL	LL2012-F3N9K
L34	6200002740	S.COIL	LL2012-F6N8K
L35	6200002440	S.COIL	LL2012-F10NK
L37	6200003870	S.COIL	NL 252018T-015J
L38	6200003870	S.COIL	NL 252018T-015J
L40	6200002740	S.COIL	LL2012-F6N8K
L41	6200002410	S.COIL	NL 252018T-056J
L42	6200002440	S.COIL	LL2012-F10NK

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
L43	6200004140	S.COIL	LL2012-F1N8S
L44	6200003490	S.COIL	LL2012-F2N2S
R1	7510000430	S.THERMISTOR	TN20-3K202LT
R2	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 k Ω)
R3	7030003240	S.RESISTOR	ERJ3GEYJ 220 V (22 Ω)
R4	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 k Ω)
R5	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R6	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R7	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R8	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R9	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R10	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 M Ω)
R11	7030003490	S.RESISTOR	ERJ3GEYJ 272 V (2.7 k Ω)
R12	7030003490	S.RESISTOR	ERJ3GEYJ 272 V (2.7 k Ω)
R13	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 k Ω)
R14	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R15	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R16	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R17	7030003450	S.RESISTOR	ERJ3GEYJ 122 V (1.2 k Ω)
R18	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R19	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 k Ω)
R20	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 k Ω)
R21	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 k Ω)
R22	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R23	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R24	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 k Ω)
R25	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 k Ω)
R26	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 k Ω)
R27	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R28	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R29	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R30	7030003370	S.RESISTOR	ERJ3GEYJ 271 V (270 Ω)
R31	7030003230	S.RESISTOR	ERJ3GEYJ 180 V (18 Ω)
R32	7030003370	S.RESISTOR	ERJ3GEYJ 271 V (270 Ω)
R33	7030003450	S.RESISTOR	ERJ3GEYJ 122 V (1.2 k Ω)
R34	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R35	7030000210	S.RESISTOR	MCR10EZJHJ 39 Ω (390)
R36	7030000210	S.RESISTOR	MCR10EZJHJ 39 Ω (390)
R37	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R38	7030003430	S.RESISTOR	ERJ3GEYJ 821 V (820 Ω)
R39	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 k Ω)
R40	7030001090	S.RESISTOR	MCR50JZHJ 47 Ω (470)
R41	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R42	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R43	7030001130	S.RESISTOR	MCR50JZHJ 100 Ω (101)
R44	7030000460	S.RESISTOR	MCR10EZJHJ 4.7 k Ω (472)
R45	7030000220	S.RESISTOR	MCR10EZJHJ 47 Ω (470)
R46	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 k Ω)
R47	7030000460	S.RESISTOR	MCR10EZJHJ 4.7 k Ω (472)
R48	7030000260	S.RESISTOR	MCR10EZJHJ 100 Ω (101)
R49	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 k Ω)
R50	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 k Ω)
R51	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 k Ω)
R52	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 k Ω)
R53	7030003570	S.RESISTOR	ERJ3GEYJ 123 V (12 k Ω)
R54	7030003610	S.RESISTOR	ERJ3GEYJ 273 V (27 k Ω)
R55	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R56	7030003800	S.RESISTOR	ERJ3GEYJ 223 V (22 k Ω)
R57	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R58	7030003790	S.RESISTOR	ERJ3GEYJ 824 V (820 k Ω)
R59	7030003540	S.RESISTOR	ERJ3GEYJ 682 V (6.8 k Ω)
R60	7030003460	S.RESISTOR	ERJ3GEYJ 152 V (1.5 k Ω)
R61	7030003490	S.RESISTOR	ERJ3GEYJ 272 V (2.7 k Ω)
R62	7310003770	S.TRIMMER	EVM-1XSX50 B34 (303)
R63	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R64	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 k Ω)
R65	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 k Ω)
R66	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 k Ω)
R67	7030003380	S.RESISTOR	ERJ3GEYJ 331 V (330 Ω)
R68	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R69	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R70	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R71	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 k Ω)
R72	7030003410	S.RESISTOR	ERJ3GEYJ 561 V (560 Ω)

S.=Surface mount

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R73	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R74	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R75	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R76	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R77	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R78	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R79	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R80	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R82	7030003240	S.RESISTOR	ERJ3GEYJ 220 V (22 Ω)
R83	7030003330	S.RESISTOR	ERJ3GEYJ 121 V (120 Ω)
R84	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 kΩ)
R85	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R86	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R87	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R88	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R89	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R90	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R91	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R92	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R93	7310003590	S.TRIMMER	EVM-1XSX50 B24 (203)
R94	7030003760	S.RESISTOR	ERJ3GEYJ 473 V (470 kΩ)
R95	7030003540	S.RESISTOR	ERJ3GEYJ 682 V (6.8 kΩ)
R97	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R98	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R99	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R100	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R101	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R102	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R103	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R104	7030003540	S.RESISTOR	ERJ3GEYJ 682 V (6.8 kΩ)
R105	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R106	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R107	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R108	7030003370	S.RESISTOR	ERJ3GEYJ 271 V (270 Ω)
R109	7030003610	S.RESISTOR	ERJ3GEYJ 273 V (27 kΩ)
R110	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R111	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R113	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R114	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R115	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R116	7030003720	S.RESISTOR	ERJ3GEYJ 224 V (220 kΩ)
R117	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R118	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R119	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R120	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R121	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R122	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R123	7030003660	S.RESISTOR	ERJ3GEYJ 683 V (68 kΩ)
R124	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R125	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R127	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R128	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R129	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R130	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 kΩ)
R131	7030003710	S.RESISTOR	ERJ3GEYJ 184 V (180 kΩ)
R132	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R133	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R134	7030003630	S.RESISTOR	ERJ3GEYJ 393 V (39 kΩ)
R135	7030003630	S.RESISTOR	ERJ3GEYJ 393 V (39 kΩ)
R136	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R137	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R138	7310003580	S.TRIMMER	EVM-1XSX50 B15 (104)
R139	7030003740	S.RESISTOR	ERJ3GEYJ 334 V (330 kΩ)
R140	7030003780	S.RESISTOR	ERJ3GEYJ 684 V (680 kΩ)
R141	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R142	7030003610	S.RESISTOR	ERJ3GEYJ 273 V (27 kΩ)
R144	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R145	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R146	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R153	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R154	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R155	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R156	7030000220	S.RESISTOR	MCR10EZJH 47 Ω (470)
R157	7030000220	S.RESISTOR	MCR10EZJH 47 Ω (470)
R158	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R159	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
R160	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R162	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R163	7030003380	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R164	7030000220	S.RESISTOR	MCR10EZJH 47 Ω (470)
R165	7030000220	S.RESISTOR	MCR10EZJH 47 Ω (470)
R166	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R167	7030003200	S.RESISTOR	ERJ3GEYJ 100 V (10 Ω)
R168	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R169	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R170	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R171	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R172	7030003440	S.RESISTOR	ERJ3GEYJ 102 V (1 kΩ)
R173	7030001010	S.RESISTOR	MCR50JZHJ 10 Ω (100)
R174	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 kΩ)
R175	7030003580	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R176	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R177	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R178	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R180	7030003770	S.RESISTOR	ERJ3GEYJ 584 V (580 kΩ)
R181	7030003800	S.RESISTOR	ERJ3GEYJ 105 V (1 MΩ)
R182	7030003500	S.RESISTOR	ERJ3GEYJ 332 V (3.3 kΩ)
R183	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 kΩ) (USA, KOR)
R184	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω) (EUR, ITA, AUS, SEA)
R184	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ) (USA, KOR)
R185	7310003600	S.TRIMMER	EVM-1XSX50 B54 (503) (USA, KOR)
R186	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ) (USA, KOR)
R187	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R188	7030003580	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R189	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R190	7030003760	S.RESISTOR	ERJ3GEYJ 474 V (470 kΩ)
R191	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R192	7030003580	S.RESISTOR	ERJ3GEYJ 153 V (15 kΩ)
R193	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R194	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R195	7030003880	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R196	7030003370	S.RESISTOR	ERJ3GEYJ 271 V (270 Ω)
R197	7030003620	S.RESISTOR	ERJ3GEYJ 333 V (33 kΩ)
R198	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R199	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R200	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R201	7030003540	S.RESISTOR	ERJ3GEYJ 682 V (6.8 kΩ)
R203	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R205	7030003640	S.RESISTOR	ERJ3GEYJ 473 V (47 kΩ)
R206	7030003680	S.RESISTOR	ERJ3GEYJ 104 V (100 kΩ)
R207	7520000120	POSISTOR	PTHM0 BC 222TS-2F333
R208	7510000180	S.THERMISTOR	TN20-3S223LT
C1	4610001260	S.TRIMMER	ECR-JA020 E12W
C2	4030007130	S.CERAMIC	C1608 CH 1H 101J-T-A
C3	4030007040	S.CERAMIC	C1608 CH 1H 180J-T-A
C4	4030007170	S.CERAMIC	C1608 CH 1H 221J-T-A
C5	4030007130	S.CERAMIC	C1608 CH 1H 101J-T-A
C6	4030008930	S.CERAMIC	C1608 CH 1H 020C-T-A
C7	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C8	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C9	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C10	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C11	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C12	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C13	4550000530	S.TANTALUM	TESVA 1V 104M1-8L
C14	4550000530	S.TANTALUM	TESVA 1V 104M1-8L
C15	4030008860	S.CERAMIC	C1608 JB 1C 153K-T-A
C16	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C17	4550002980	S.TANTALUM	TEMSVA 1C 225M-8L
C18	4550002980	S.TANTALUM	TEMSVA 1C 225M-8L
C19	4550002980	S.TANTALUM	TEMSVA 1C 225M-8L
C20	4030008670	S.CERAMIC	C1608 SL 1H 270J-T-A
C21	4510005430	S.ELECTROLITIC	ECEV0JA220R
C22	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A
C23	4030008860	S.CERAMIC	C1608 JB 1H 102K-T-A

S.=Surface mount

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C24	4550002750	S.TANTALUM TESVD2 1A 336M-12L
C25	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C26	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C27	4030006930	S.CERAMIC C1608 CH 1H 020C-T-A
C28	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C29	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C30	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C31	4550000450	S.TANTALUM TESVC 1C 106M-12L
C33	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C34	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C35	4030006660	S.CERAMIC C1608 SL 1H 220J-T-A
C36	4030006660	S.CERAMIC C1608 SL 1H 220J-T-A
C37	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C38	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C39	4030006630	S.CERAMIC C1608 SL 1H 150J-T-A
C40	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C41	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C42	4030006690	S.CERAMIC C1608 SL 1H 330J-T-A
C43	4030006540	S.CERAMIC C1608 SL 1H 030C-T-A
C44	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C45	4030006690	S.CERAMIC C1608 SL 1H 330J-T-A
C46	4030006540	S.CERAMIC C1608 SL 1H 030C-T-A
C47	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C48	4030006660	S.CERAMIC C1608 SL 1H 220J-T-A
C49	4030006640	S.CERAMIC C1608 SL 1H 180J-T-A
C50	4030006640	S.CERAMIC C1608 SL 1H 180J-T-A
C51	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C52	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C53	4010003880	CERAMIC DD06 SL 150K 500V
C54	4010004120	CERAMIC DD07 B 102K 500V
C55	4010003930	CERAMIC DD06 SL 270K 500V
C56	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C57	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C58	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C59	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C60	4010003920	CERAMIC DD06 SL 240K 500V
C61	4010003920	CERAMIC DD08 SL 240K 500V
C62	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C63	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C64	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C65	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C66	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C67	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C68	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C69	4550000450	S.TANTALUM TESVC 1C 106M-12L
C70	4550000450	S.TANTALUM TESVC 1C 106M-12L
C71	4550003080	S.TANTALUM TEMSVA 1A 335M-8L
C72	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C73	4550000450	S.TANTALUM TESVC 1C 106M-12L
C74	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C75	4030006900	S.CERAMIC C1608 JB 1E 103K-T-A
C76	4030006900	S.CERAMIC C1608 JB 1E 103K-T-A
C77	4030006900	S.CERAMIC C1608 JB 1E 103K-T-A
C78	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C79	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C81	4030006610	S.CERAMIC C1608 SL 1H 100D-T-A
C82	4030006660	S.CERAMIC C1608 SL 1H 220J-T-A
C83	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C84	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C85	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C86	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C87	4030006620	S.CERAMIC C1608 SL 1H 120J-T-A
C88	4030006740	S.CERAMIC C1608 SL 1H 820J-T-A
C89	4030006520	S.CERAMIC C1608 SL 1H 010C-T-A
C90	4030006560	S.CERAMIC C1608 SL 1H 050C-T-A
C91	4030006740	S.CERAMIC C1608 SL 1H 820J-T-A
C92	4030008800	S.CERAMIC C1608 SL 1H 090D-T-A
C94	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C95	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C96	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C97	4030006890	S.CERAMIC C1608 SL 1H 330J-T-A
C98	4030006620	S.CERAMIC C1608 SL 1H 120J-T-A
C99	4030006600	S.CERAMIC C1608 SL 1H 090D-T-A
C100	4030006640	S.CERAMIC C1608 SL 1H 180J-T-A
C101	4030006520	S.CERAMIC C1608 SL 1H 010C-T-A
C102	4030006630	S.CERAMIC C1608 SL 1H 150J-T-A

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION
C103	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C104	4030006530	S.CERAMIC C1608 SL 1H 020C-T-A
C105	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C106	4030006560	S.CERAMIC C1608 SL 1H 050C-T-A
C107	4030006560	S.CERAMIC C1608 SL 1H 050C-T-A
C108	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C109	4550000550	S.TANTALUM TESVA 1V 224M1-8L
C110	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C111	4550003030	S.TANTALUM TEMSVA 0J 475M-8L
C112	4550003030	S.TANTALUM TEMSVA 0J 475M-8L
C113	4030008920	S.CERAMIC C1608 JB 1C 473K-T-A
C114	4030008920	S.CERAMIC C1608 JB 1C 473K-T-A
C115	4030008870	S.CERAMIC C1608 SL 1H 270J-T-A
C116	4030008880	S.CERAMIC C1608 JB 1H 102K-T-A
C117	4510005430	S.ELECTROLITIC ECEV0JA220R
C118	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C119	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C120	4550002750	S.TANTALUM TESVD2 1A 336M-12L
C121	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C122	4030007010	S.CERAMIC C1608 CH 1H 100D-T-A
C123	4030007110	S.CERAMIC C1608 CH 1H 680J-T-A
C124	4030009990	S.CERAMIC C1608 CH 1H 200J-T-A
C125	4030008630	S.CERAMIC C1608 JF 1C 104Z-T-A
C126	4510004540	S.ELECTROLITIC ECEV0JA470P
C127	4030008900	S.CERAMIC C1608 JB 1E 103K-T-A
C128	4030008900	S.CERAMIC C1608 JB 1E 103K-T-A
C129	4030006790	S.CERAMIC C1608 SL 1H 181J-T-A
C130	4030008900	S.CERAMIC C1608 JB 1E 103K-T-A
C131	4030008630	S.CERAMIC C1608 JF 1C 104Z-T-A
C132	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C133	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C134	4030008690	S.CERAMIC C2012 JF 1C 105Z-T-A
C135	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C136	4030006870	S.CERAMIC C1608 JB 1H 222K-T-A
C137	4030008880	S.CERAMIC C1608 JB 1H 472K-T-A
C138	4030009000	S.CERAMIC C2012 JB 1C 224K-T-A
C139	4030007120	S.CERAMIC C1608 CH 1H 820J-T-A
C140	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C141	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C142	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C143	4030008680	S.CERAMIC C2012 JF 1C 105Z-T-A
C144	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C145	4030006900	S.CERAMIC C1608 JB 1E 103K-T-A
C146	4030006900	S.CERAMIC C1608 JB 1E 103K-T-A
C147	4030008630	S.CERAMIC C1608 JF 1C 104Z-T-A
C148	4510005860	S.ELECTROLITIC ECEV1HA2R2SR
C149	4030006880	S.CERAMIC C1608 JB 1H 472K-T-A
C150	4030006870	S.CERAMIC C1608 JB 1H 222K-T-A
C151	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C152	4030008630	S.CERAMIC C1608 JF 1C 104Z-T-A
C153	4030008630	S.CERAMIC C1608 JF 1C 104Z-T-A
C155	4030008690	S.CERAMIC C2012 JF 1C 105Z-T-A
C156	4030008680	S.CERAMIC C2012 JF 1C 105Z-T-A
C158	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C160	4030006860	S.CERAMIC C1608 JB 1H 102K-T-A
C182	4030006570	S.CERAMIC C1608 SL 1H 090D-T-A
C184	4030006550	S.CERAMIC C1608 SL 1H 040C-T-A
C185	4510005430	S.ELECTROLITIC ECEV0JA220R
C186	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C187	4030006570	S.CERAMIC C1608 SL 1H 080D-T-A
C188	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C189	4030006620	S.CERAMIC C1608 SL 1H 120J-T-A
C170	4030006710	S.CERAMIC C1608 SL 1H 470J-T-A
C171	4030006620	S.CERAMIC C1608 SL 1H 120J-T-A
C172	4030008580	S.CERAMIC C1608 SL 1H 070D-T-A
C173	4030006630	S.CERAMIC C1608 SL 1H 150J-T-A
C174	4030006530	S.CERAMIC C1608 SL 1H 020C-T-A
C175	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C176	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C177	4030008860	S.CERAMIC C1608 JB 1H 102K-T-A
C178	4030006540	S.CERAMIC C1608 SL 1H 030C-T-A
C180	4030008550	S.CERAMIC C1608 SL 1H 040C-T-A
C181	4510005430	S.ELECTROLITIC ECEV0JA220R
C182	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A
C183	4030006540	S.CERAMIC C1608 SL 1H 030C-T-A
C184	4030006850	S.CERAMIC C1608 JB 1H 471K-T-A

S.=Surface mount

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C185	4030006550	S.CERAMIC	C1608 SL 1H 040C-T-A
C186	4030006560	S.CERAMIC	C1608 SL 1H 050C-T-A
C187	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C188	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C189	4030006600	S.CERAMIC	C1608 SL 1H 090D-T-A
C190	4030006570	S.CERAMIC	C1608 SL 1H 060D-T-A
C191	4030006570	S.CERAMIC	C1608 SL 1H 060D-T-A
C192	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C193	4510005300	S.ELECTROLITIC	ECEV1AA330P
C194	4510005820	S.ELECTROLITIC	ECEV1CA101P
C195	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C196	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C197	4510004640	S.ELECTROLITIC	ECEV1CA470P
C198	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C199	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C200	4510005300	S.ELECTROLITIC	ECEV1AA330P
C202	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C203	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C204	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C205	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C206	4510004600	ELECTROLITIC	16 MV 1000 HC
C207	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C208	4510005300	S.ELECTROLITIC	ECEV1AA330P
C210	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C211	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C212	4510005820	S.ELECTROLITIC	ECEV1CA101P
C213	4510004650	S.ELECTROLITIC	ECEV1EA4R7R
C214	4510004640	S.ELECTROLITIC	ECEV1CA470P
C215	4510004540	S.ELECTROLITIC	ECEV0JA470P
C216	4510004640	S.ELECTROLITIC	ECEV1CA470P
C217	4510005880	S.ELECTROLITIC	ECEV1AA471P
C218	4550000540	S.TANTALUM	TESVA 1V 154M1-8L
C219	4030008630	S.CERAMIC	C1608 JF 1C 104Z-T-A
C220	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C221	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C222	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C223	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C224	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C225	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C226	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C227	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C228	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C229	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C230	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C231	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C232	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C233	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C234	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C235	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C236	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C237	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C238	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C239	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C240	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C241	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C242	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C243	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C244	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C245	4510004650	S.ELECTROLITIC	ECEV1EA4R7R (USA, KOR)
C246	4030007690	S.CERAMIC	C1608 CH 1H 470J-T-A (USA, KOR)
C247	4030007080	S.CERAMIC	C1608 CH 1H 390J-T-A (USA, KOR)
C248	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A (USA, KOR)
C249	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C250	4510004630	S.ELECTROLITIC	ECEV1CA100R
C251	4510005310	S.ELECTROLITIC	ECEV1CA220R
C252	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C253	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C254	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C255	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C256	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C257	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C258	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A

[MAIN UNIT]

REF. NO.	ORDER NO.	DESCRIPTION	
C261	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C262	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C263	4010003800	CERAMIC	DD08 SL 030C 500V
C264	4030008710	S.MICA	UC232H 0120F
C265	4030006710	S.CERAMIC	C1608 SL 1H 470J-T-A
C266	4030006760	S.CERAMIC	C1608 SL 1H 121J-T-A
C267	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C268	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C270	4030008440	S.CERAMIC	C1608 SL 1H 1R5C-T-A
C271	4030006530	S.CERAMIC	C1608 SL 1H 020C-T-A
C272	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C273	4030006860	S.CERAMIC	C2012 JF 1C 105Z-T-A
C274	4510001850	ELECTROLITIC	16 MS5 4R7UF
W1	8900002450	CABLE	OPC-223
W2	8900004880	CABLE	OPC-465
W3	7030003860	S.JUMPER	ERJ3GE JPW V
W4	7030003860	S.JUMPER	ERJ3GE JPW V
W5	7030003860	S.JUMPER	ERJ3GE JPW V
W8	7030003860	S.JUMPER	ERJ3GE JPW V
W9	7030003860	S.JUMPER	ERJ3GE JPW V
W10	7030003860	S.JUMPER	ERJ3GE JPW V
W11	7030003860	S.JUMPER	ERJ3GE JPW V
W12	7030003860	S.JUMPER	ERJ3GE JPW V
W13	7030000010	S.JUMPER	MCR10EZJ JPW (000)
W14	7030003860	S.JUMPER	ERJ3GE JPW V
W16	7030003860	S.JUMPER	ERJ3GE JPW V
W18	7030000010	S.JUMPER	MCR10EZJ JPW (000)
W20	7030003860	S.JUMPER	ERJ3GE JPW V (USA, KOR)
W21	7030003860	S.JUMPER	ERJ3GE JPW V
J2	6510012800	CONNECTOR	53020-3010
J4	6510012880	S.CONNECTOR	CEW9114-0201
J5	6510005020	CONNECTOR	TXL-P03P-C1
J6	6450001480	CONNECTOR	HSJ1488-01-010
EPI	0910040973	PCB	B 4065C

[VCO-A BOARD]

REF. NO.	ORDER NO.	DESCRIPTION	
Q1	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q2	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q3	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q4	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q5	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q6	1530002920	S.TRANSISTOR	2SC4226-T2 R25
Q7	1530002920	S.TRANSISTOR	2SC4226-T2 R25
D1	1720000370	S.VARICAP	HVU350TRF
D2	1790000620	S.DIODE	MA77(TW)
L1	6200001520	S.COIL	MLF2012D R82K-T
L2	6130002480	S.COIL	LB-277
L3	6200002840	S.COIL	NL 252018T-R22J
L4	6200002840	S.COIL	NL 252018T-R22J
L5	6200002580	S.COIL	NL 252018T-033J
R1	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R2	7030003600	S.RESISTOR	ERJ3GEYJ 223 V (22 kΩ)
R3	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R4	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 kΩ)
R5	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R6	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 kΩ)
R7	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R8	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)

S.=Surface mount

[VCO-A BOARD]

REF. NO.	ORDER NO.	DESCRIPTION	
R9	7030003490	S.RESISTOR	ERJ3GEYJ 272 V (2.7 kΩ)
R10	7030003510	S.RESISTOR	ERJ3GEYJ 392 V (3.9 kΩ)
R11	7030003430	S.RESISTOR	ERJ3GEYJ 821 V (820 Ω)
R12	7030003360	S.RESISTOR	ERJ3GEYJ 221 V (220 Ω)
R13	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
R14	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
R15	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
R16	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R17	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R18	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R19	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R20	7030003420	S.RESISTOR	ERJ3GEYJ 681 V (680 Ω)
R21	7030003520	S.RESISTOR	ERJ3GEYJ 470 V (4.7 kΩ)
R22	7030003480	S.RESISTOR	ERJ3GEYJ 222 V (2.2 kΩ)
R23	7030003520	S.RESISTOR	ERJ3GEYJ 472 V (4.7 kΩ)
R24	7030003400	S.RESISTOR	ERJ3GEYJ 471 V (470 Ω)
R25	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R27	7030003650	S.RESISTOR	ERJ3GEYJ 563 V (56 kΩ)
R28	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
C2	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C3	4030007050	S.CERAMIC	C1608 CH 1H 220J-T-A
C4	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C5	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C6	4030006910	S.CERAMIC	C1608 CH 1H 0R5C-T-A
C7	4030006910	S.CERAMIC	C1608 CH 1H 0R5C-T-A
C8	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C9	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C10	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C11	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C12	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C13	4030006670	S.CERAMIC	C1608 SL 1H 270J-T-A
C14	4030006520	S.CERAMIC	C1608 SL 1H 010C-T-A
C15	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C16	4030006570	S.CERAMIC	C1608 SL 1H 075C-T-A
C17	4030006660	S.CERAMIC	C1608 SL 1H 220J-T-A
C18	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C19	4030006510	S.CERAMIC	C1608 SL 1H 0R5C-T-A
C20	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C21	4030006610	S.CERAMIC	C1608 SL 1H 100D-T-A
C22	4030006850	S.CERAMIC	C1608 JB 1H 471K-T-A
C23	4030006570	S.CERAMIC	C1608 SL 1H 060D-T-A
C24	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C25	4030006660	S.CERAMIC	C1608 JB 1H 102K-T-A
C26	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C27	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
J1	6910006500	CONNECTOR	IMSA-9210B-1-07Z204-T
J2	6910006200	CONNECTOR	IMSA-9210B-1-08Z 204T
EPI	0910040942	PCB	B 4067B

[VCO-B BOARD]

REF. NO.	ORDER NO.	DESCRIPTION	
Q1	1560000490	S.FET	2SK508 K52 T2B
Q2	1530003120	S.TRANSISTOR	2SC3120(TE85R)
Q3	1540000420	S.TRANSISTOR	2SD1851-TA
Q4	1590001330	S.TRANSISTOR	DTA114EU T107
Q5	1530003180	S.TRANSISTOR	2SC4211-7-TR
Q6	1580000490	S.FET	2SK508 K52 T2B
Q7	1530003120	S.TRANSISTOR	2SC3120(TE85R)
D1	1720000380	S.VARICAP	1T33C T8
D2	1720000380	S.VARICAP	1T33C T8
D3	1720000380	S.VARICAP	1T33C T8
D4	1720000380	S.VARICAP	1T33C T8
L1	6200003510	S.COIL	LER015T R82M
L2	6200003510	S.COIL	LER015T R82M
L3	6130002750	S.COIL	LB-310
L4	6200001570	S.COIL	LER 015T 1R0M

[VCO-B BOARD]

REF. NO.	ORDER NO.	DESCRIPTION	
L5	6200001530	S.COIL	LER 015T 3R3K
L6	6200000770	S.COIL	LQN 2A 68NM
L7	6200001550	S.COIL	LER 015T R56M
L8	6200001550	S.COIL	LER 015T R56M
L9	6200000110	S.COIL	LQN 2A 33NM
L10	6200001570	S.COIL	LER 015T 1R0M
L11	6200001550	S.COIL	LER 015T R56M
L12	6200000770	S.COIL	LQN 2A 68NM
R1	7030003550	S.RESISTOR	ERJ3GEYJ 822 V (8.2 kΩ)
R2	7030003260	S.RESISTOR	ERJ3GEYJ 330 V (33 Ω)
R3	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R4	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R5	7030003510	S.RESISTOR	ERJ3GEYJ 392 V (3.9 kΩ)
R6	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R7	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
R8	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
R9	7030003650	S.RESISTOR	ERJ3GEYJ 563 V (56 kΩ)
R10	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R11	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R12	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R13	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R14	7030003290	S.RESISTOR	ERJ3GEYJ 560 V (56 Ω)
R15	7030003280	S.RESISTOR	ERJ3GEYJ 470 V (47 Ω)
R16	7030003560	S.RESISTOR	ERJ3GEYJ 103 V (10 kΩ)
R17	7030003510	S.RESISTOR	ERJ3GEYJ 392 V (3.9 kΩ)
R18	7030003320	S.RESISTOR	ERJ3GEYJ 101 V (100 Ω)
R19	7030003220	S.RESISTOR	ERJ3GEYJ 150 V (15 Ω)
C1	4550000550	S.TANTALUM	TESVA 1V 224M1-8L
C2	4030006670	S.CERAMIC	C1608 SL 1H 270J-T-A
C4	4030006930	S.CERAMIC	C1608 CH 1H 020C-T-A
C5	4030006960	S.CERAMIC	C1608 CH 1H 050C-T-A
C6	4030006940	S.CERAMIC	C1608 CH 1H 030C-T-A
C7	4030006520	S.CERAMIC	C1608 SL 1H 010C-T-A
C8	4030006550	S.CERAMIC	C1608 SL 1H 040C-T-A
C9	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C10	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C11	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C12	4550000530	S.TANTALUM	TESVA 1V 104M1-8L
C13	4030006740	S.CERAMIC	C1608 SL 1H 820J-T-A
C14	4030007020	S.CERAMIC	C1608 CH 1H 120J-T-A
C15	4030006950	S.CERAMIC	C1608 CH 1H 040C-T-A
C16	4030006520	S.CERAMIC	C1608 SL 1H 010C-T-A
C17	4030006860	S.CERAMIC	C1608 JB 1H 102K-T-A
C18	4030006550	S.CERAMIC	C1608 SL 1H 040C-T-A
EPI	0910040951	PCB	B 4068A

S.=Surface mount

SECTION 6 MECHANICAL PARTS AND DISASSEMBLY

6-1 CHASSIS PARTS

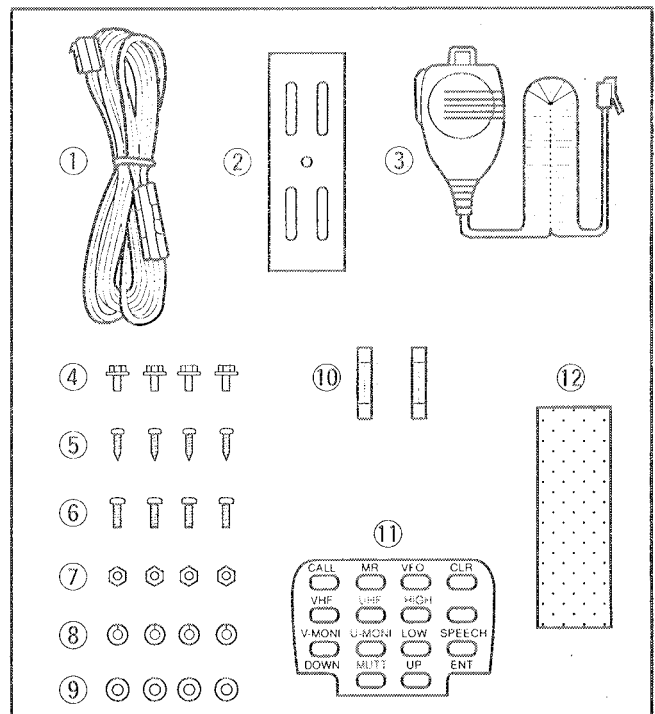
LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
①	8610009030	Knob N-211 (A) [VOLUME]	1
②	8610009040	Knob N-212 (A) [SQL]	1
③	8610008960	Knob N-210 [MAIN DIAL]	1
④	8210010980	1346 Front panel	1
⑤	8810002120	Screw FH M2.6 x 6	4
⑥	8930031450	1346 LCD rubber	1
⑦	8930030810	1346 LCD holder	1
⑧	5030001050	LCD FTD-12578AAH	1
⑨	8930031681	LCD contact SRCN-1346SC	1
⑩	8930031440	1346 LCD filter	1
⑪	8830000790	VR nut (H)	2
⑫	8210010030	1346 Reflector	1
⑬	8930007050	Isolating plate (Z)	1
⑭	8930017940	AF-IC clip	1
⑮	8930031090	1346 SP holder	1
⑯	8930020650	IC clip	1
⑰	2510000690	Speaker VS-50-0820A	1
⑱	8930032430	Isolating sheet (DI)	1

LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
⑲	8930031660	Sheet (AO)	1
⑳	8110005200	1346 Top cover	1
㉑	8810003100	Screw OH M2.6 x 5 BS ZK	8
㉒	8930032450	1346 SP-T sponge	1
㉓	8930032410	1346 V-plate	1
㉔	8810007730	Set screw (c) 2.6 x 5 ZK	2
㉕	8900004880	DC cable OPC-465	1
㉖	8930031650	1346 APC-TR clip	1
㉗	8010015380	1346 Chassis	1
㉘	8900002450	ANT cable OPC-223	1
㉙	6950000040	M-type cap (Black)	1
⑳	8810001170	Screw PH B0 3 x 6 NI	2
㉑	8810008200	Screw PH B0 2.6 x 6 NI (BT)	9
㉒	8110005210	1346 Bottom cover	1
㉓	8930031760	Rubber sheet (N)	1
㉔	8810007230	Set screw (H) 3 x 8	2
㉕	6450001470	Connector 95003-2881	1

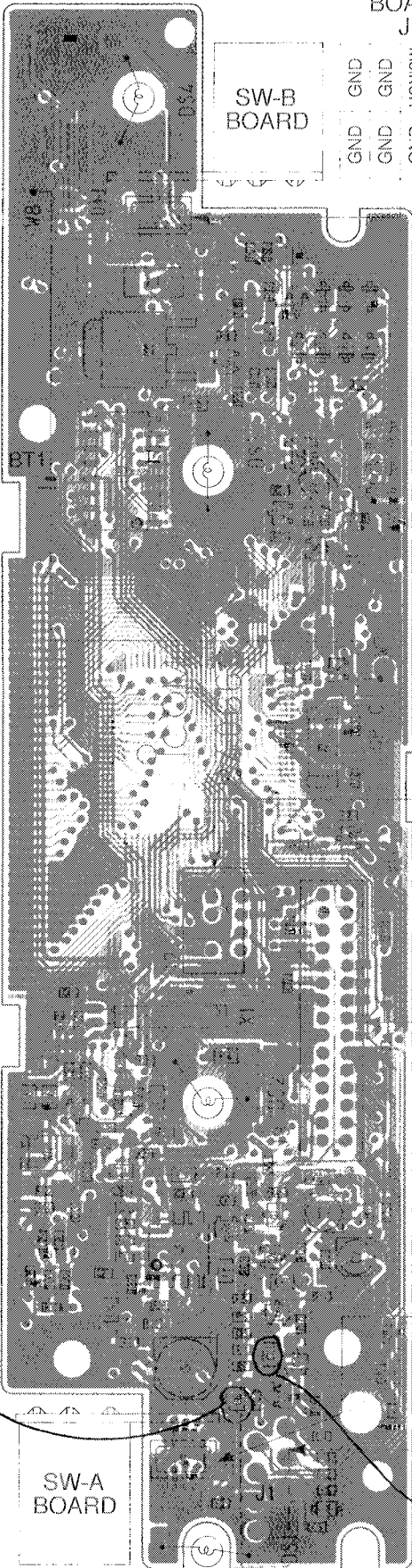
Screw abbreviations: PH: Pan head OH: Oval countersunk head

6-2 ACCESSORIES

LABEL NO.	ORDER NO.	DESCRIPTION	QTY.
①	8930003760	DC power cable (OPC-346)	1
②	Optional product	Mounting bracket (MB-27)	1
③	Optional product	Microphone HM-77 (USA/KOR versions)	1
		Microphone HM-78 (AUS/SEA versions)	1
		Microphone HM-79 (EUR/ITA versions)	1
④	8820000530	Mounting bolt	4
⑤	8810000950	Screw PH A M5 x 16	4
⑥	8810000490	Screw PH (+, -) M5 x 12	4
⑦	8830000120	Nut (M5)	4
⑧	8850000390	Spring washer M5	4
⑨	8850000150	Flat washer M5 Ni BS	4
⑩	5210000080	Fuses (20 A)	2
⑪	8310022240	Microphone sheet for HM-77	1
⑫	8930008050	Mounting felts (A): sponge	2



• LOGIC UNIT (BOTTOM VIEW)



SW-B BOARD
J1

GND	GND	GND	MONISW	DUP	GND
GND	GND	GND	DCK	GND	GND

MA8062
D1
AC → JK
Symbol: 6_2

1SS352
D9 (EUR, USA)
D10, D12 (except KOR, AUS)
D11 (EUR, USA, SEA)
D13 (except KOR, ITA)
D14 (EUR, AUS)
D15 (All versions)
D16 (except KOR, AUS)
D17 (KOR, AUS, SEA)
D18 (KOR)
D19 (EUR, ITA, KOR)

AC → JK
Symbol: C1

VOICE SYNTHESIZER UNIT
(OPTION UT-66)

DATA	STBSP
CK	SBUSY
GND	+5V
VOICE	UNITS

C5V	UNLKB
13.8V	UNLKA
STBPLA	CK
STBPLB	DATA
+5V	STBTO

tone	UNITT
S/RF	TSQL
SQL	STBCO
GND	PTT
MIC	MICE
AFE	SVOL
VOL2	+8V
MOD	MMUTE
VOL1	RPT
DETO	PACKET

MAIN UNIT
J2

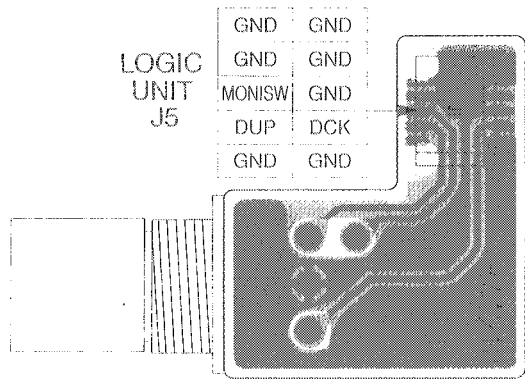
AFE	AFE	VOL1	PWR/SW	GND
GND	VOL2	5V	SVOL	GND

SW-A BOARD
J1

UP/DOWN	8V
PTT	AF OUT
MIC	MIC E
NC	GND

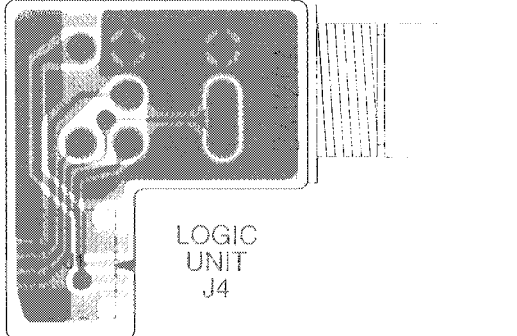
MIC JACK
C11

• SW-B BOARD (BOTTOM VIEW)



GND	GND
GND	GND
MONISW	GND
DUP	DCK
GND	GND

• SW-A BOARD (BOTTOM VIEW)



LOGIC UNIT
J4

2SJ144 Y
Q2, Q3, Q7, Q24
Symbol: VY

2SC4211
Q5, Q17, Q22
Symbol: L7

2SA1622
Q18
Symbol: M6

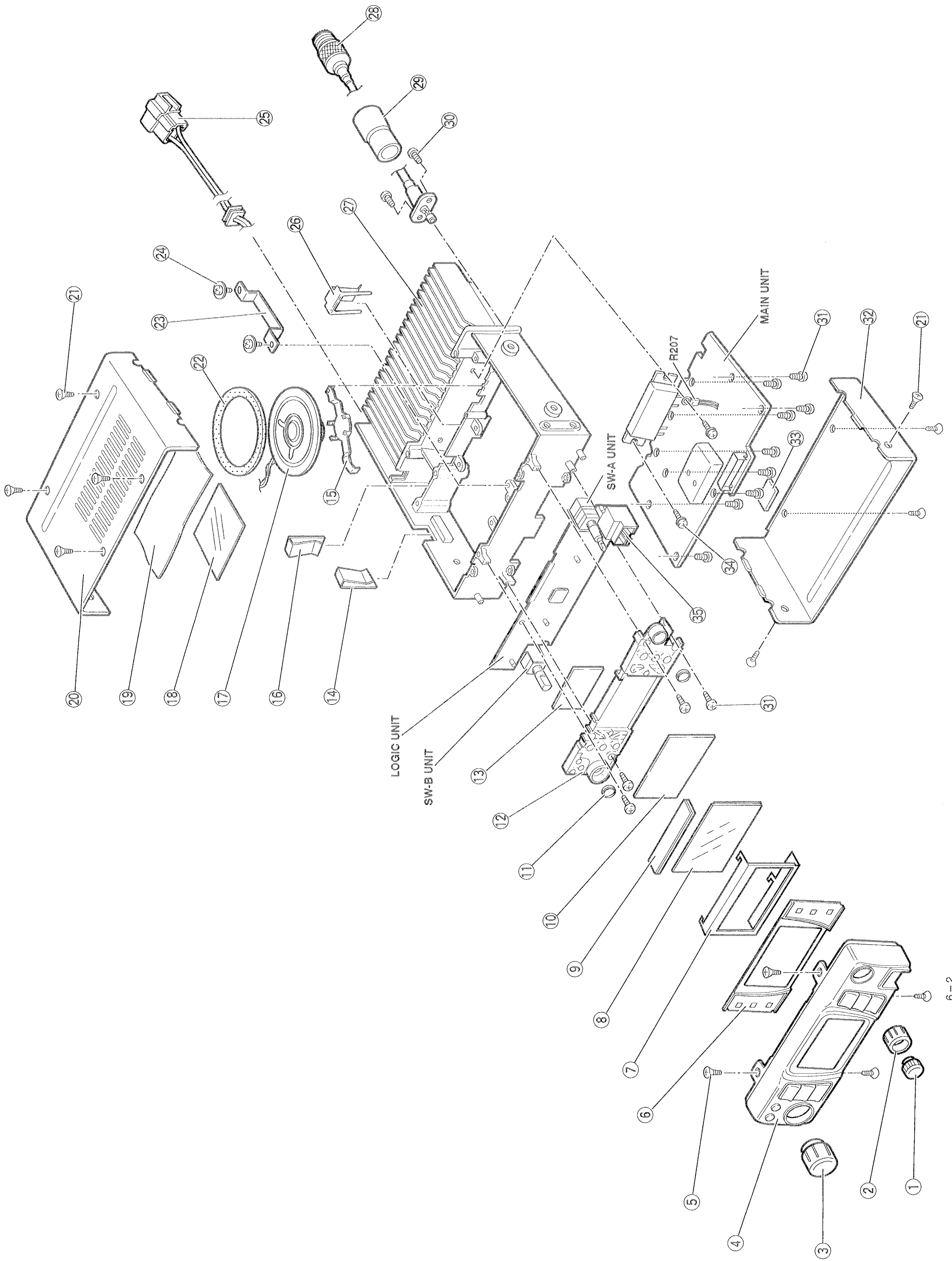
2SC4116
Q19, Q21
Symbol: LY

DTC144 EU
Q8, Q16
Symbol: 26

1SS301
D4
Symbol: B3

C10 for scramble

Surface Inside Underside

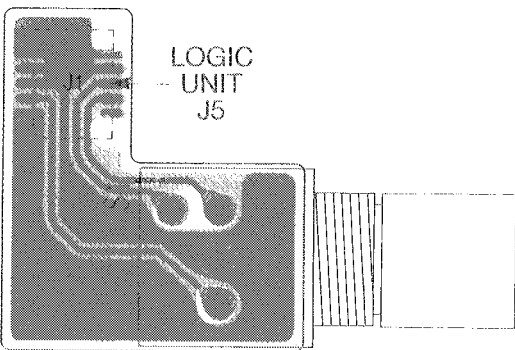


SECTION 7 BOARD LAYOUTS

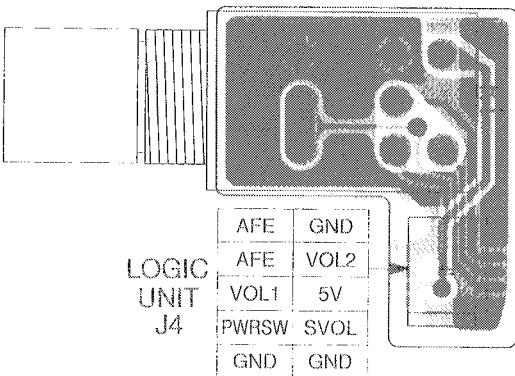
7-1 LOGIC UNIT

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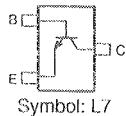
• SW-B BOARD (TOP VIEW)



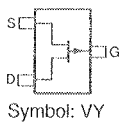
• SW-A BOARD (TOP VIEW)



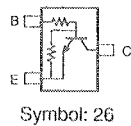
2SC4211
Q1, Q10, Q11,
Q15, Q23



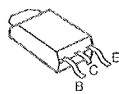
2SJ144 Y
Q9, Q12, Q13



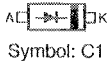
DTC144 EU
Q4, Q14



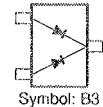
2SB1201 S
Q8



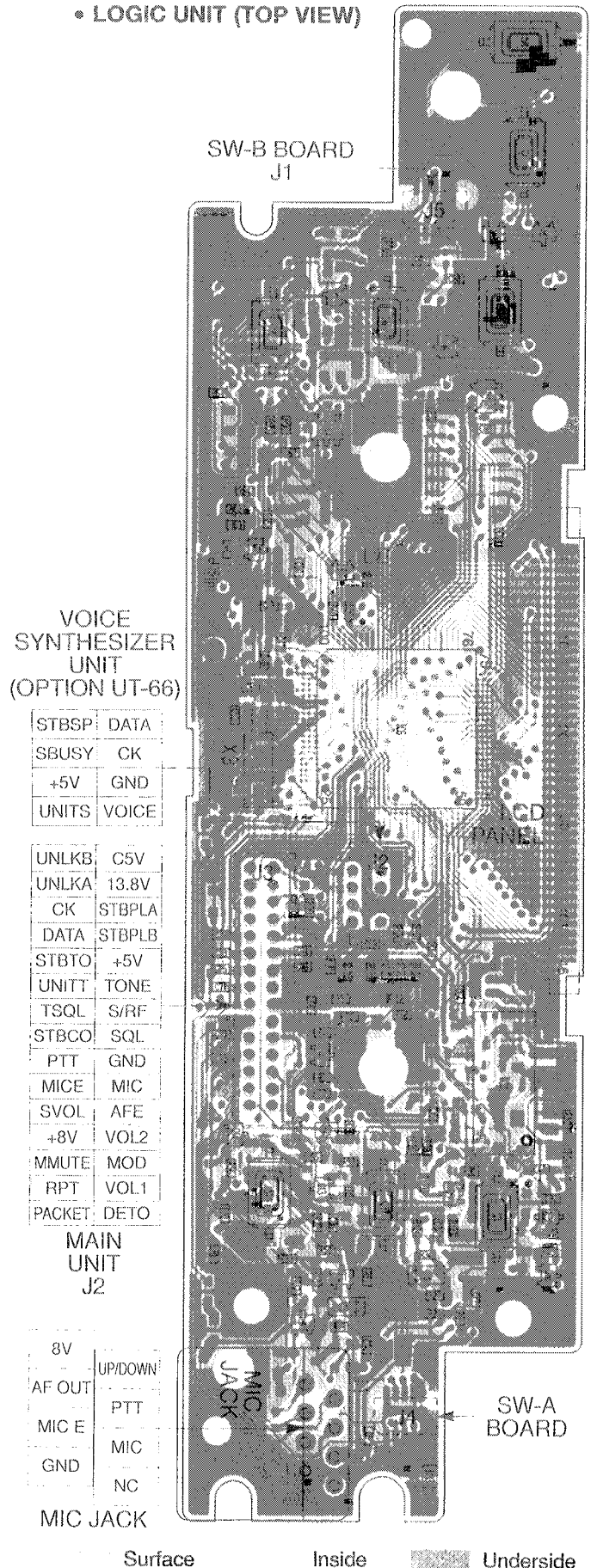
1SS352
D2, D3



1SS301
D5, D6, D7, D8



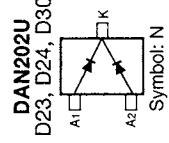
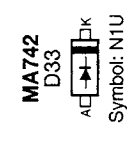
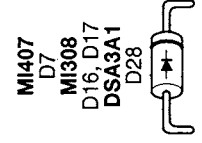
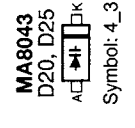
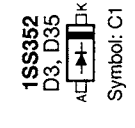
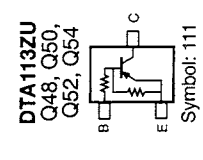
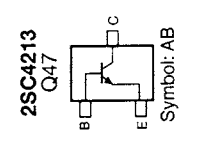
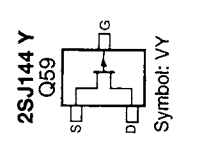
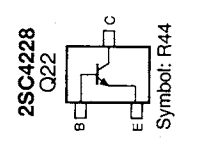
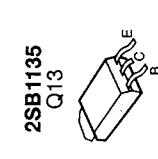
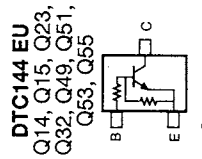
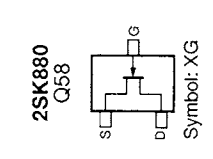
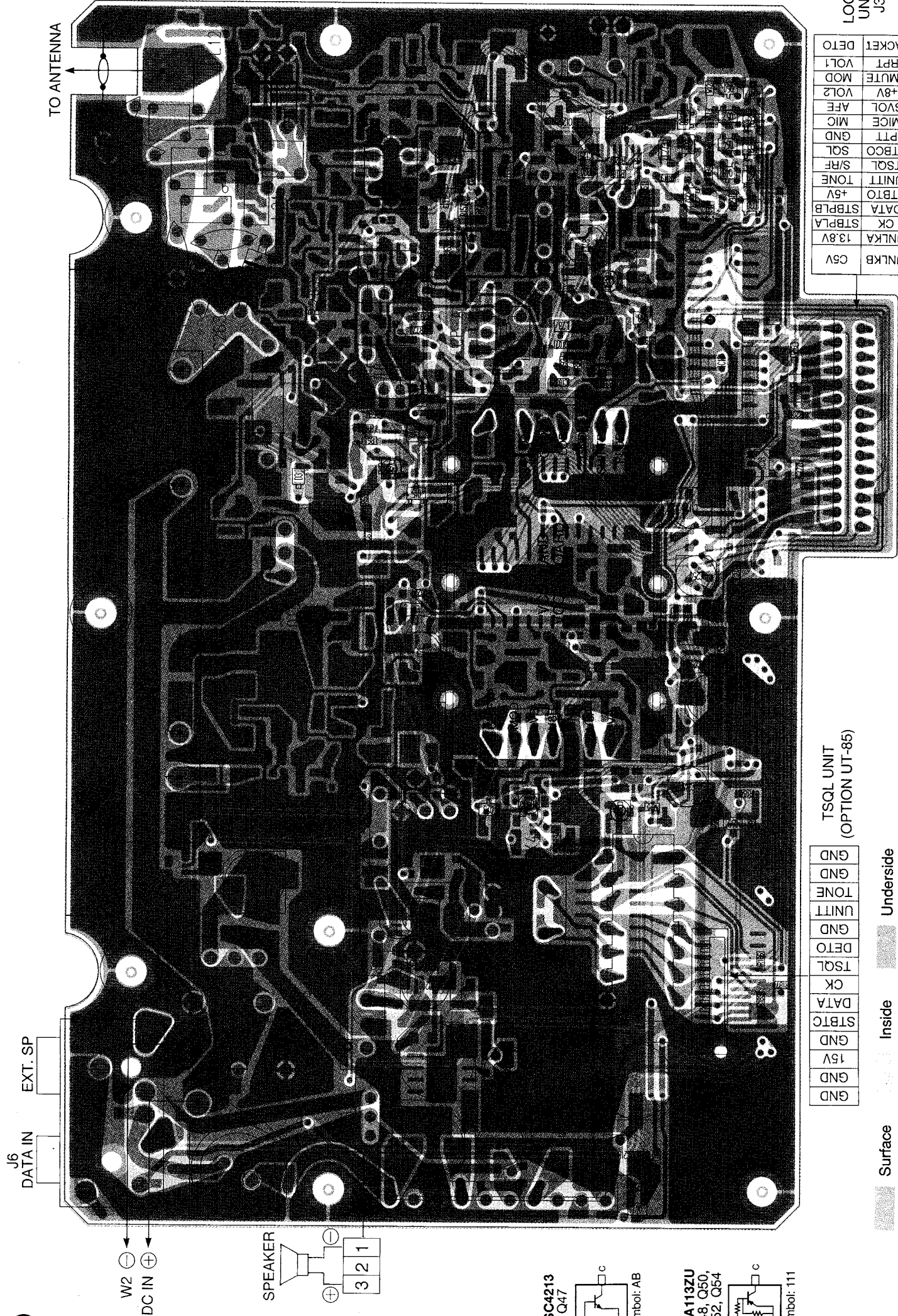
• LOGIC UNIT (TOP VIEW)



The combination of this page and the next page shows the unit layout in the same configuration as the actual P.C. Board.

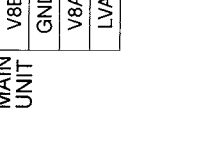
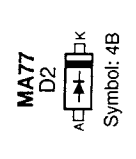
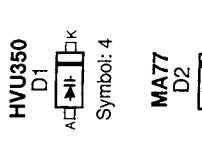
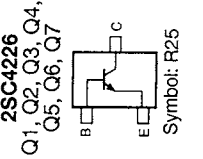
7-2 MAIN UNIT

• MAIN UNIT (TOP VIEW)

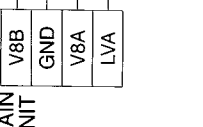
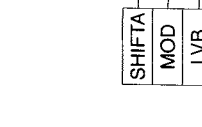
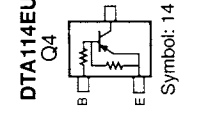
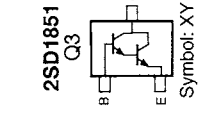
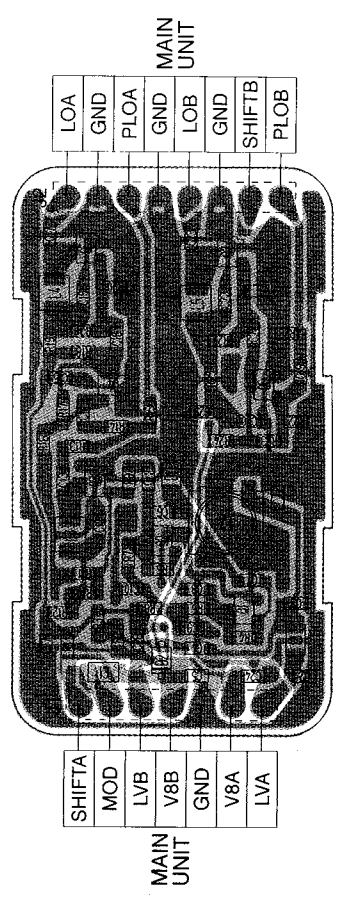


UNLKB	C5V
UNLKA	13.8V
CK	STBPLA
DATA	STBPLB
STBTO	+5V
UNITT	TSOL
TSQL	S/R/F
STBCO	SQ
PTT	GND
MICE	MIC
SVOL	A/E
+8V	VOL2
MMUTE	MOD
RPT	VOL1
PACKET	DETO

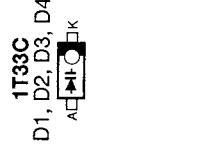
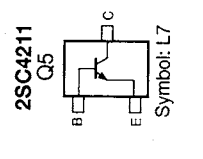
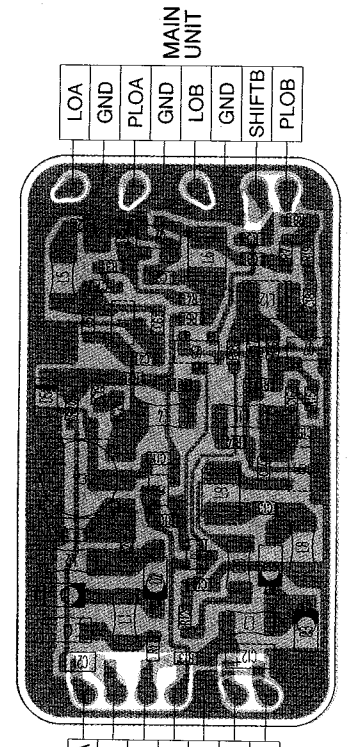
Surface Inside Underside



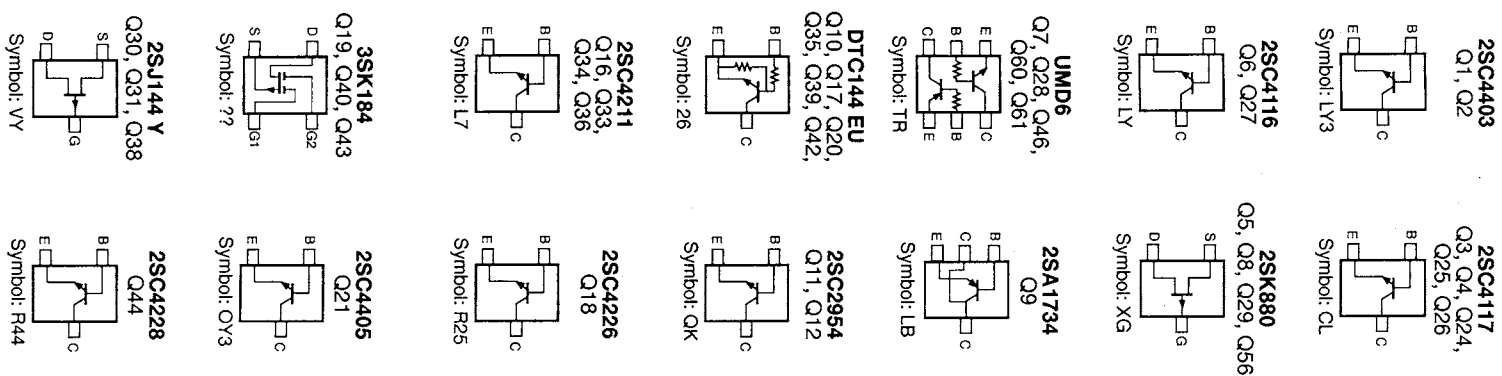
• VCO-A BOARD (TOP VIEW)



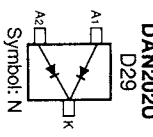
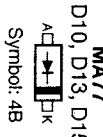
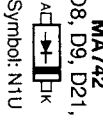
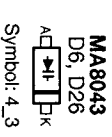
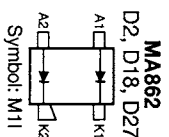
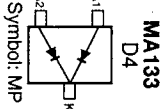
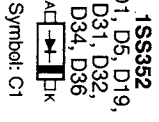
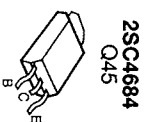
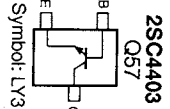
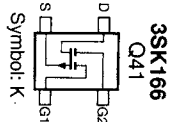
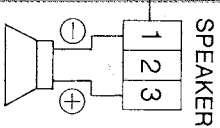
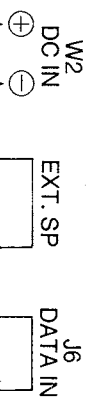
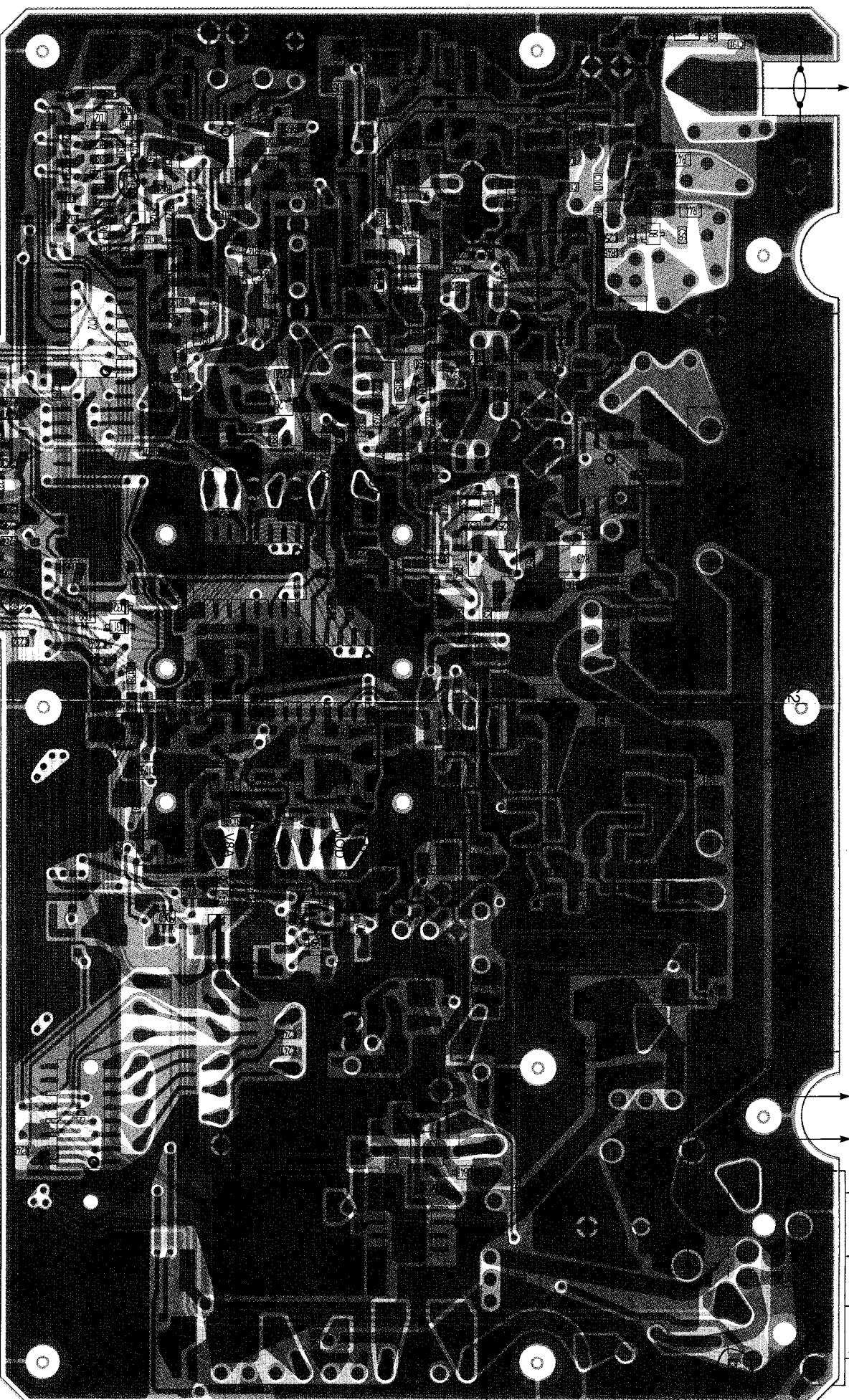
• VCO-B BOARD (TOP VIEW)



• MAIN UNIT (BOTTOM VIEW)



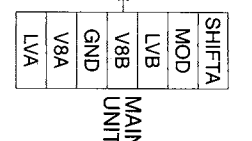
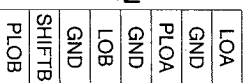
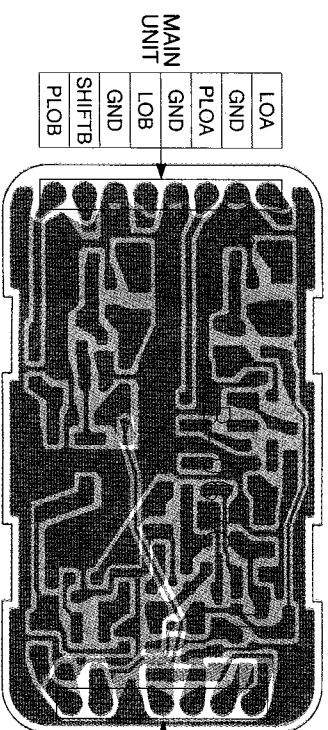
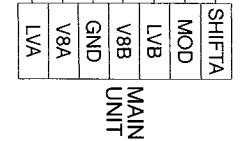
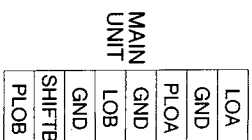
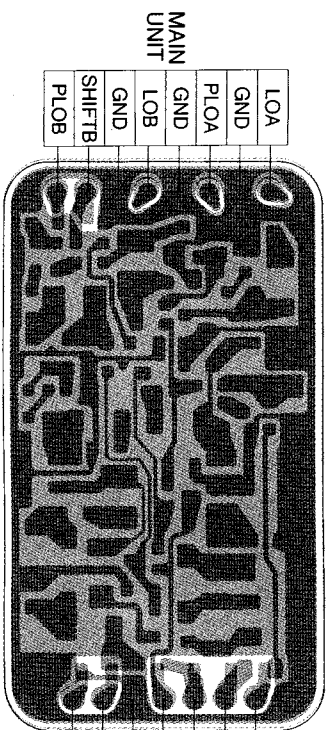
TO ANTENNA



PACKET	DETO
RPT	VOL1
MMUTE	MOD
+8V	VOL2
SVOL	AFE
MICE	MIC
PTT	GND
STBCO	SQL
TSQL	S/RF
UNITT	STONE
STBTO	+5V
DATA	STBPLB
CK	STBPLA
UNLKA	13.8V
UNLKB	C5V

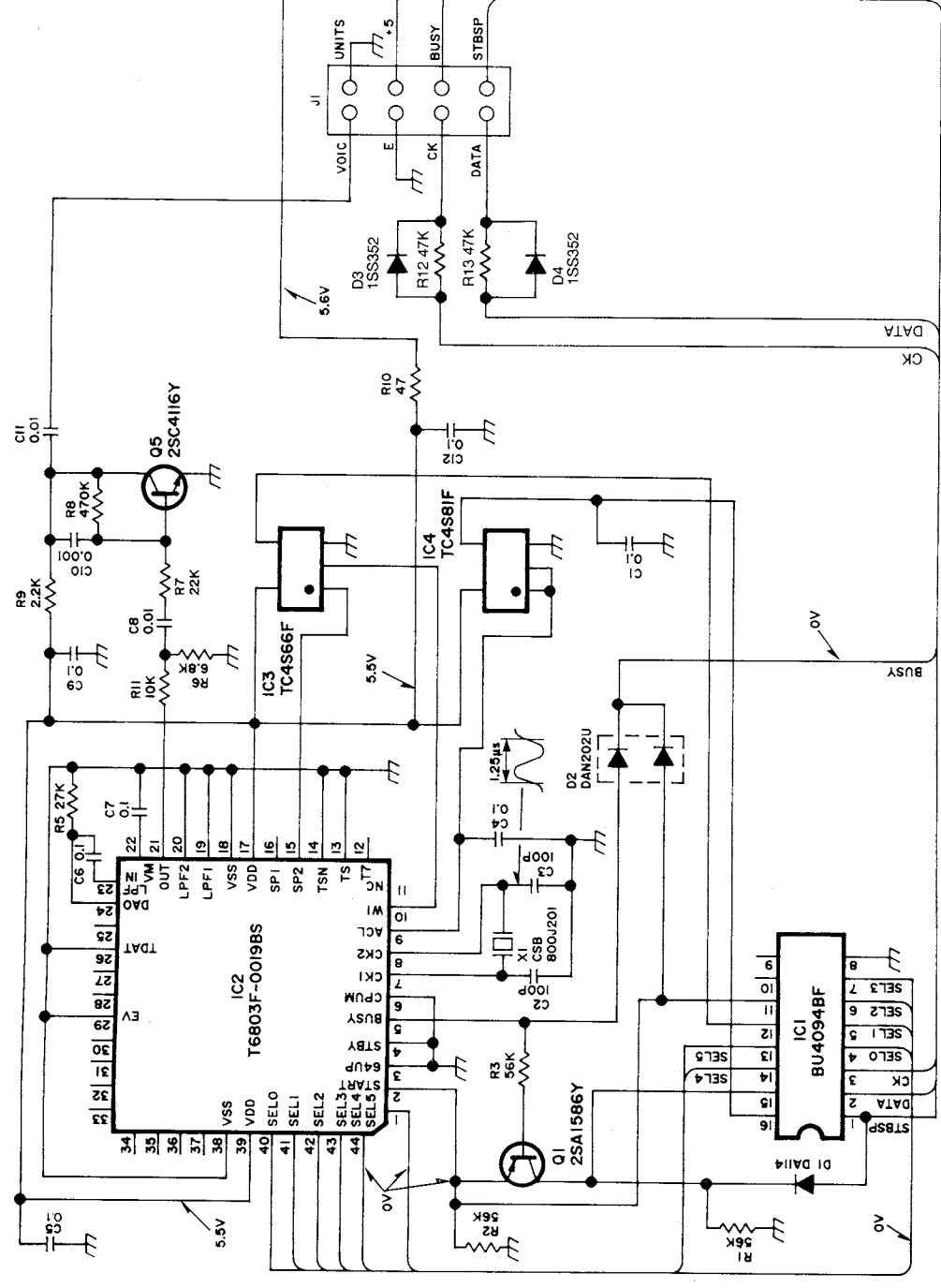


• VCO-A BOARD (BOTTOM VIEW)

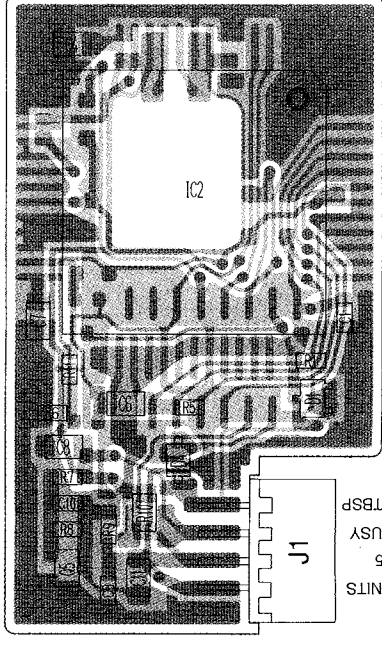


SECTION 8 OPTIONAL UNITS

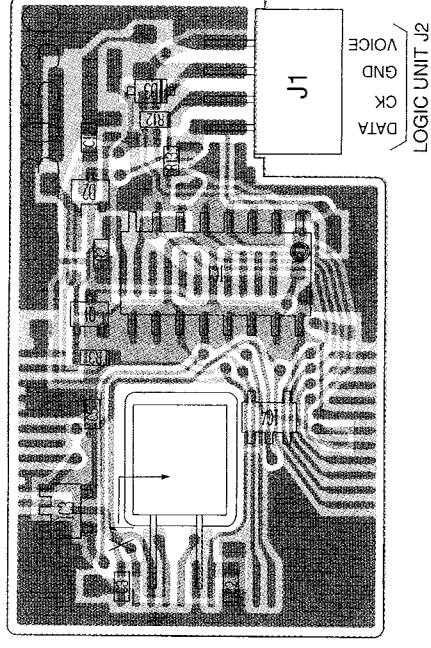
8-1 UT-66 VOICE SYNTHESIZER UNIT



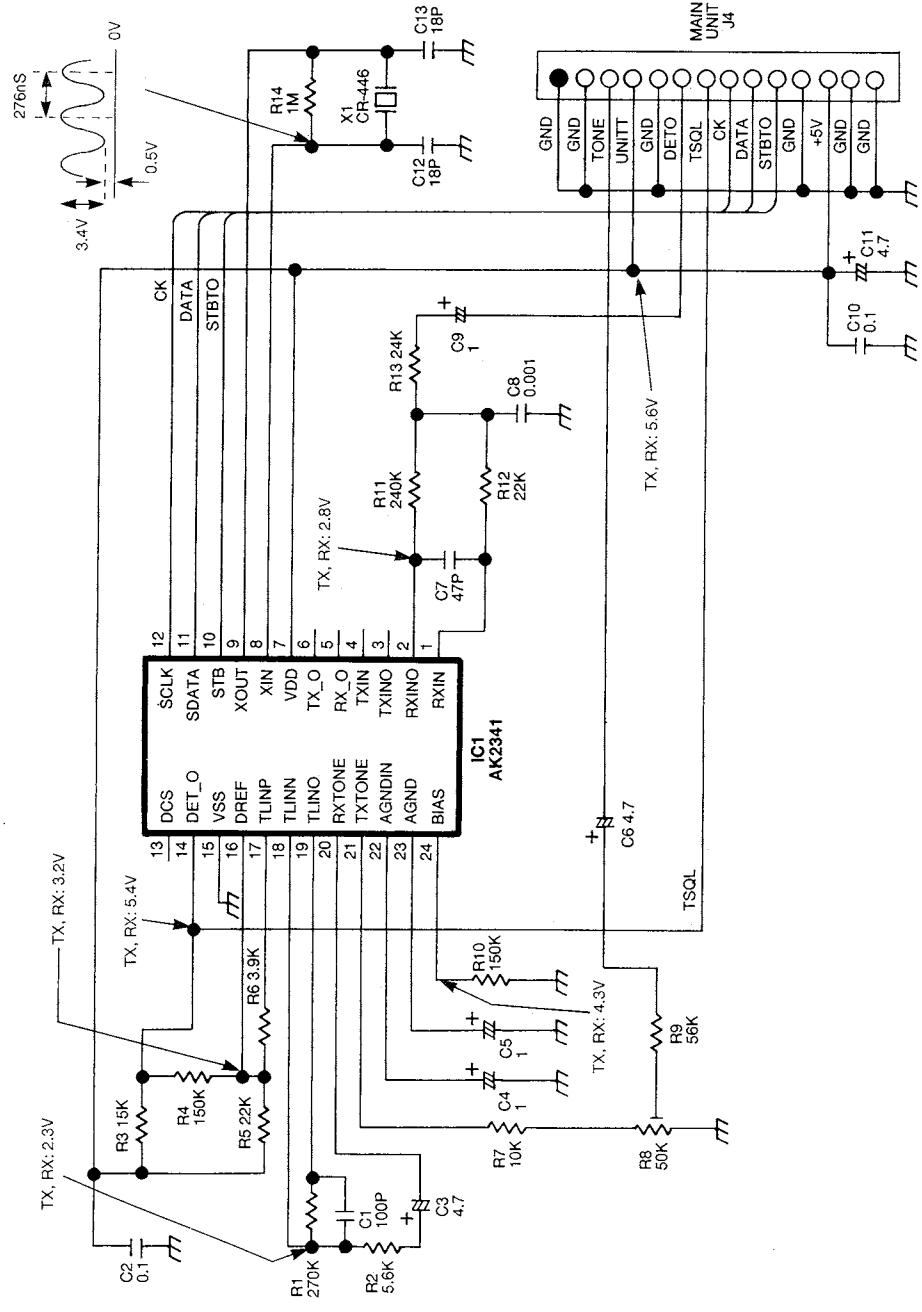
• BOARD LAYOUT (TOP VIEW)



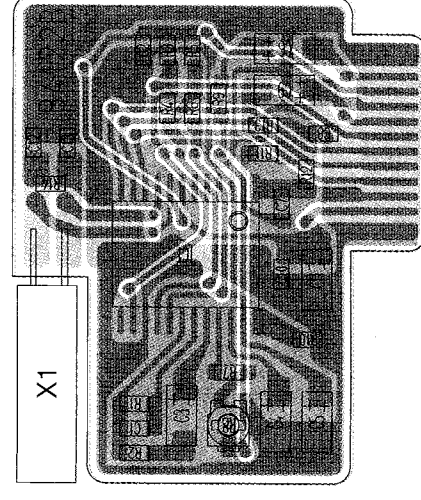
• BOARD LAYOUT (BOTTOM VIEW)



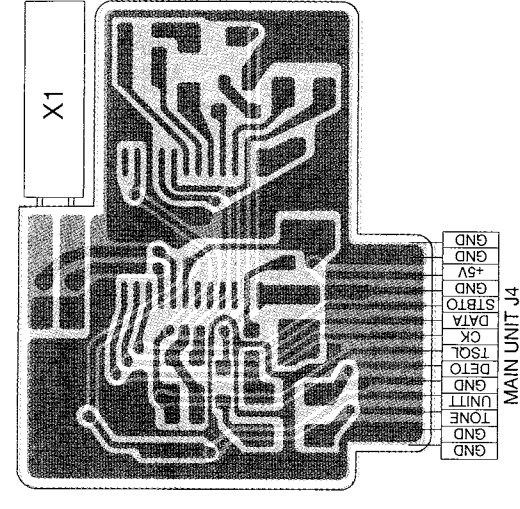
8-2 UT-85 TONE SQUELCH UNIT



• BOARD LAYOUT (TOP VIEW)

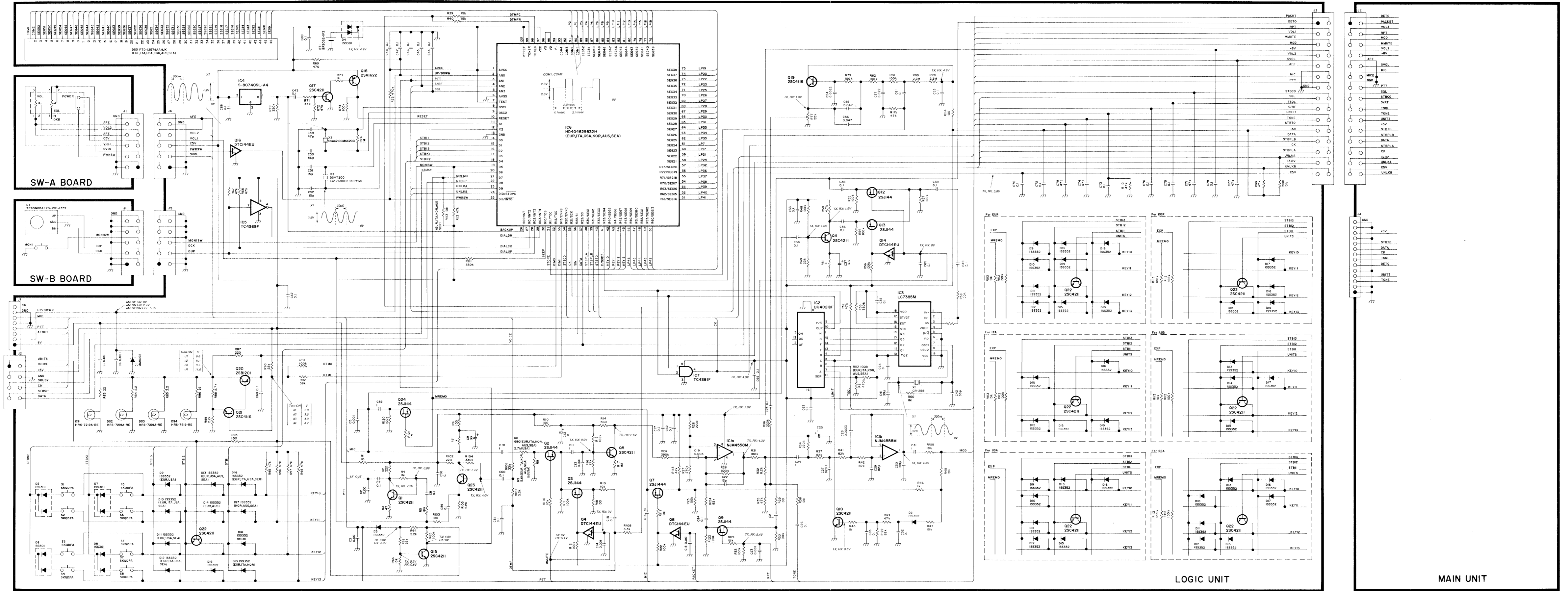


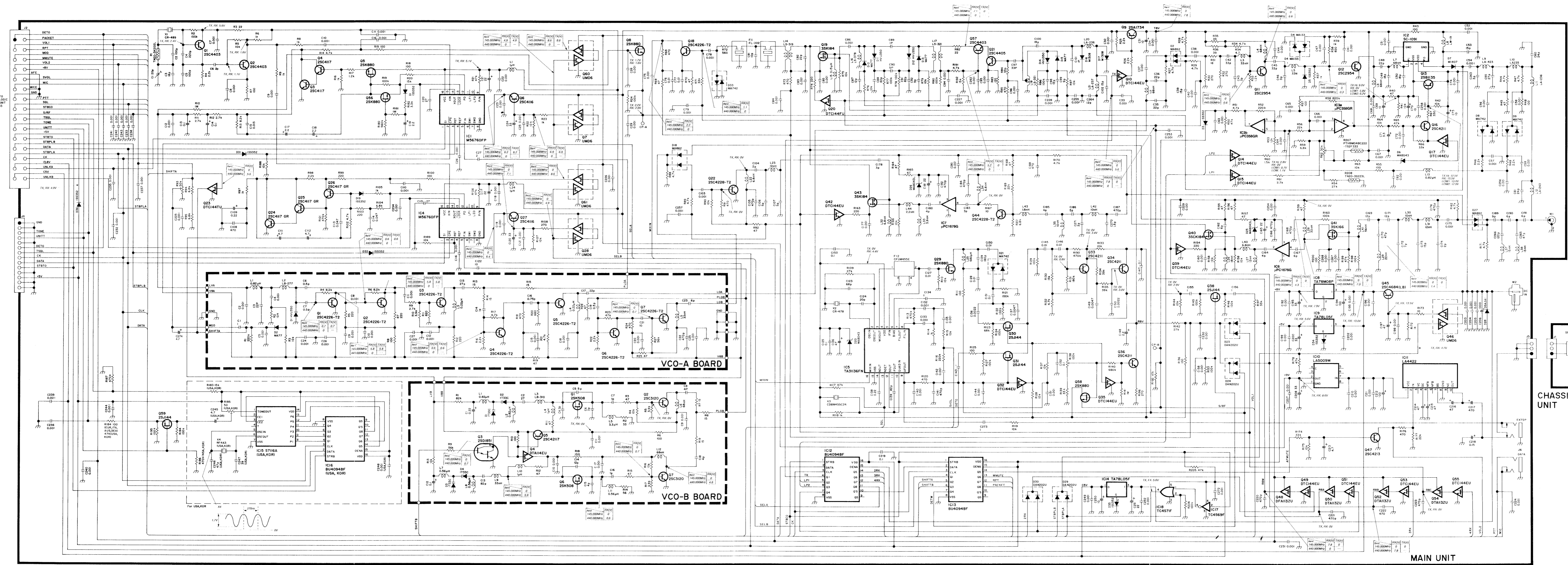
• BOARD LAYOUT (BOTTOM VIEW)



SECTION 10 VOLTAGE DIAGRAMS

10-1 LOGIC UNIT





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Count on us!

iCOM

**SERVICE
MANUAL**

144 MHz FM TRANSCEIVER

IC-228A

IC-228E

IC-228H

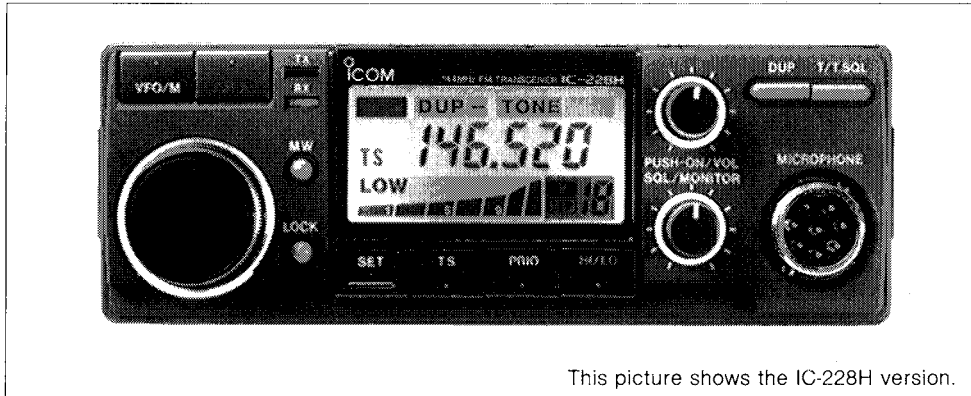
CPU RESET

- 1) LOCK
 - 2) MONITOR
 - 3) OFF ON
-

BT1 - BR 2037 - LT2

SCOPE OF THE SERVICE MANUAL

This service manual covers all service information related to the theoretical, physical, mechanical and electrical characteristics of the **IC-228A/E/H 144 MHz FM TRANSCEIVER**.



This picture shows the IC-228H version.

ASSISTANCE

If you require assistance or further information regarding the operation, capability and servicing of the **IC-228A/E/H**, contact your nearest authorized Icom Dealer or Icom Service Center. Addresses are provided on the inside back cover for your convenience.

ORDERING PARTS

Be sure to include the following five points when ordering replacement parts or requesting equipment information from your dealer or Icom Service Center. This will ensure faster, more efficient service.

1. Equipment model and serial number
2. Schematic part identifier or service manual page number
3. Unit name and printed circuit board number (e.g., MAIN UNIT/B-1680B)
4. Component part number and name (e.g., SC-1019 IC)
5. Quantity required (e.g., 5 pcs.)

REPAIR NOTE

1. **DO NOT** open transceiver covers until the transceiver is disconnected from a power source.
2. **DO NOT** connect the transceiver to an external power source of more than 15V.
3. **DO NOT** force any of the variable components. Turn them slowly and smoothly.
4. **DO NOT** short any circuits or electronic parts.
5. An insulated tuning tool **MUST BE** used for all adjustments.
6. **DO NOT** keep power ON for a long time when the transceiver is defective.
7. **DO NOT** transmit power into a signal generator or sweep generator.
8. **Always** connect a 20dB or 30dB attenuator between the transceiver and a deviation meter or spectrum analyzer when using such test equipment.
9. Read the instructions of test equipment thoroughly before connecting equipment to the transceiver.

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SECTION 1 SPECIFICATIONS

■ GENERAL

- Frequency coverage :

MODEL	VERSION	RECEIVER	TRANSMITTER
IC-228A/H	U.S.A.	138.00 ~ 174.00 MHz*	140.00 ~ 150.00 MHz*
IC-228A/H	Australia	144.00 ~ 148.00 MHz	144.00 ~ 148.00 MHz
IC-228A/H	Asia	138.00 ~ 174.00 MHz*	140.00 ~ 150.00 MHz*
IC-228E/H	Europe	144.00 ~ 146.00 MHz	144.00 ~ 146.00 MHz
IC-228E/H	Italy	140.00 ~ 150.00 MHz*	140.00 ~ 150.00 MHz*

*Specifications apply to 144.00 ~ 148.00 MHz only.
- Mode : F3 (FM)
- Selectable tuning step (Initial) : 5, 10, 15, 20 and 25 kHz (U.S.A., Australia, Asia versions)
12.5 and 25 kHz (Europe, Italy versions)
- Memory channels : 20 plus a call channel
- Antenna impedance : 50 Ω
- Power supply requirement : 13.8 V DC ± 15% (negative ground)
- Current drain (IC-228H) : Receive 450 mA (standby)
800 mA (max. audio output)
Transmit 3.5 A (LOW)
9.5 A (HIGH)
- Current drain (IC-228A/E) : Receive 450 mA (standby)
800 mA (max. audio output)
Transmit 3.0 A (LOW)
6.0 A (HIGH)
- Usable temperature range : -10°C ~ +60°C (+14°F ~ +140°F)
- Frequency stability : ±10 ppm (-10°C ~ +60°C) (+14°F ~ +140°F)
- Dimensions : IC-228H 140(W) × 50(H) × 159(D) mm, 5.5(W) × 2.0(H) × 6.3(D) in.
IC-228A/E 140(W) × 50(H) × 137(D) mm, 5.5(W) × 2.0(H) × 5.4(D) in.
(Projections not included)
- Weight : IC-228H 1.1 kg (2.4 lb)
IC-228A/E 0.85 kg (1.9 lb)

■ TRANSMITTER

- Output power : IC-228H 45 W (HIGH), 5 W (LOW)
IC-228A/E 25 W (HIGH), 5 W (LOW)
- Modulation system : Variable reactance frequency modulation
- Max. frequency deviation : ±5 kHz
- Spurious emissions : Less than -60 dB
- Microphone impedance : 600 Ω

■ RECEIVER

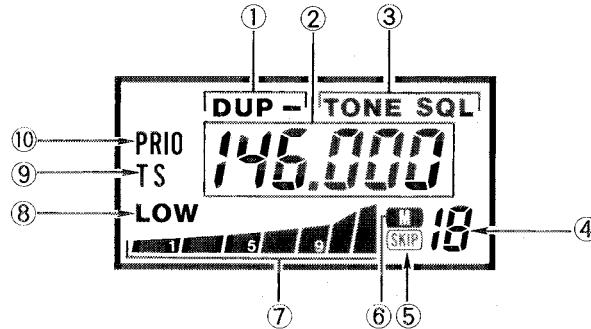
- Receiver system : Double-conversion superheterodyne
- Intermediate frequencies : 1st 17.2 MHz
2nd 455 kHz
- Sensitivity : 0.18 μV for 12 dB SINAD
- Selectivity : More than 15 kHz/ -6 dB
Less than 30 kHz/ -60 dB
- Audio output power : More than 2.4 W at 10% distortion with an 8 Ω load
- Audio output impedance : 8 Ω

All stated specifications are subject to change without notice or obligation.

SECTION 2 OUTSIDE AND INSIDE VIEWS

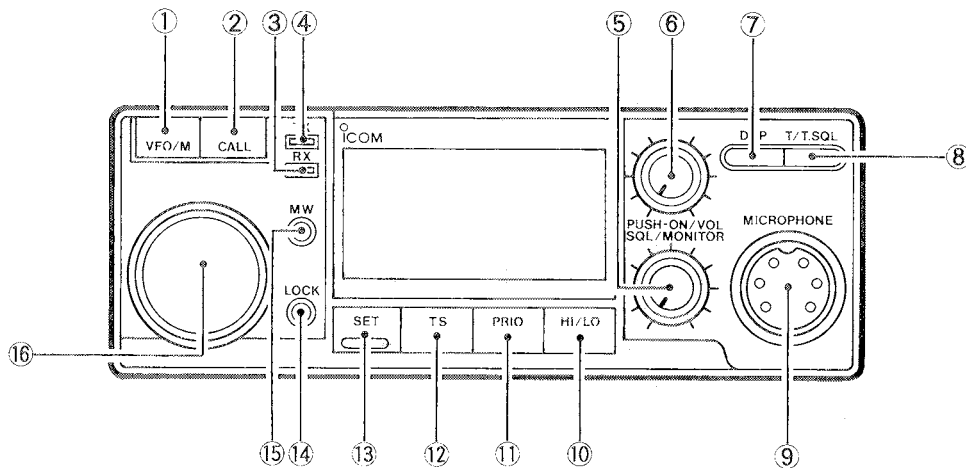
2-1 FREQUENCY DISPLAY

- | | |
|--------------------------|-------------------------|
| ① DUPLEX INDICATOR | ⑥ MEMORY INDICATOR |
| ② FREQUENCY READOUT | ⑦ S/R/F INDICATOR |
| ③ TONE INDICATOR | ⑧ LOW POWER INDICATOR |
| ④ MEMORY CHANNEL READOUT | ⑨ TUNING STEP INDICATOR |
| ⑤ SKIP CHANNEL INDICATOR | ⑩ PRIORITY INDICATOR |



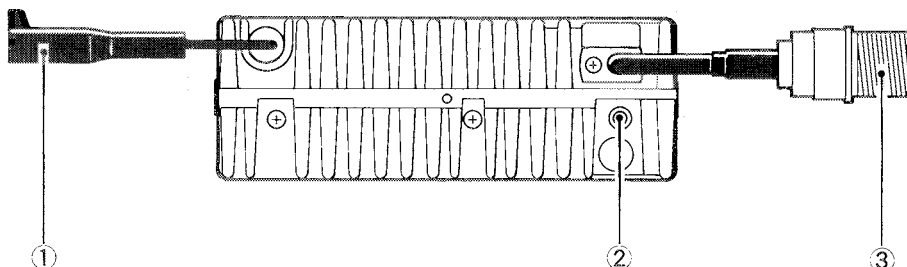
2-2 FRONT PANEL

- | | |
|--|---------------------------------|
| ① VFO/MEMORY SWITCH [VFO/M] | ⑨ MICROPHONE CONNECTOR |
| ② CALL CHANNEL SWITCH [CALL] | ⑩ TRANSMIT POWER SWITCH [HI/LO] |
| ③ RECEIVE INDICATOR [RX] | ⑪ PRIORITY SWITCH [PRIO] |
| ④ TRANSMIT INDICATOR [TX] | ⑫ TUNING STEP SWITCH [TS] |
| ⑤ SQUELCH CONTROL/MONITOR SWITCH [SQL/MONITOR] | ⑬ SET MODE SWITCH [SET] |
| ⑥ POWER SWITCH/VOLUME CONTROL [ON/VOL] | ⑭ LOCK SWITCH [LOCK] |
| ⑦ DUPLEX SWITCH [DUP] | ⑮ MEMORY WRITE SWITCH [MW] |
| ⑧ TONE SWITCH [T/T. SQL] | ⑯ MAIN TUNING DIAL |

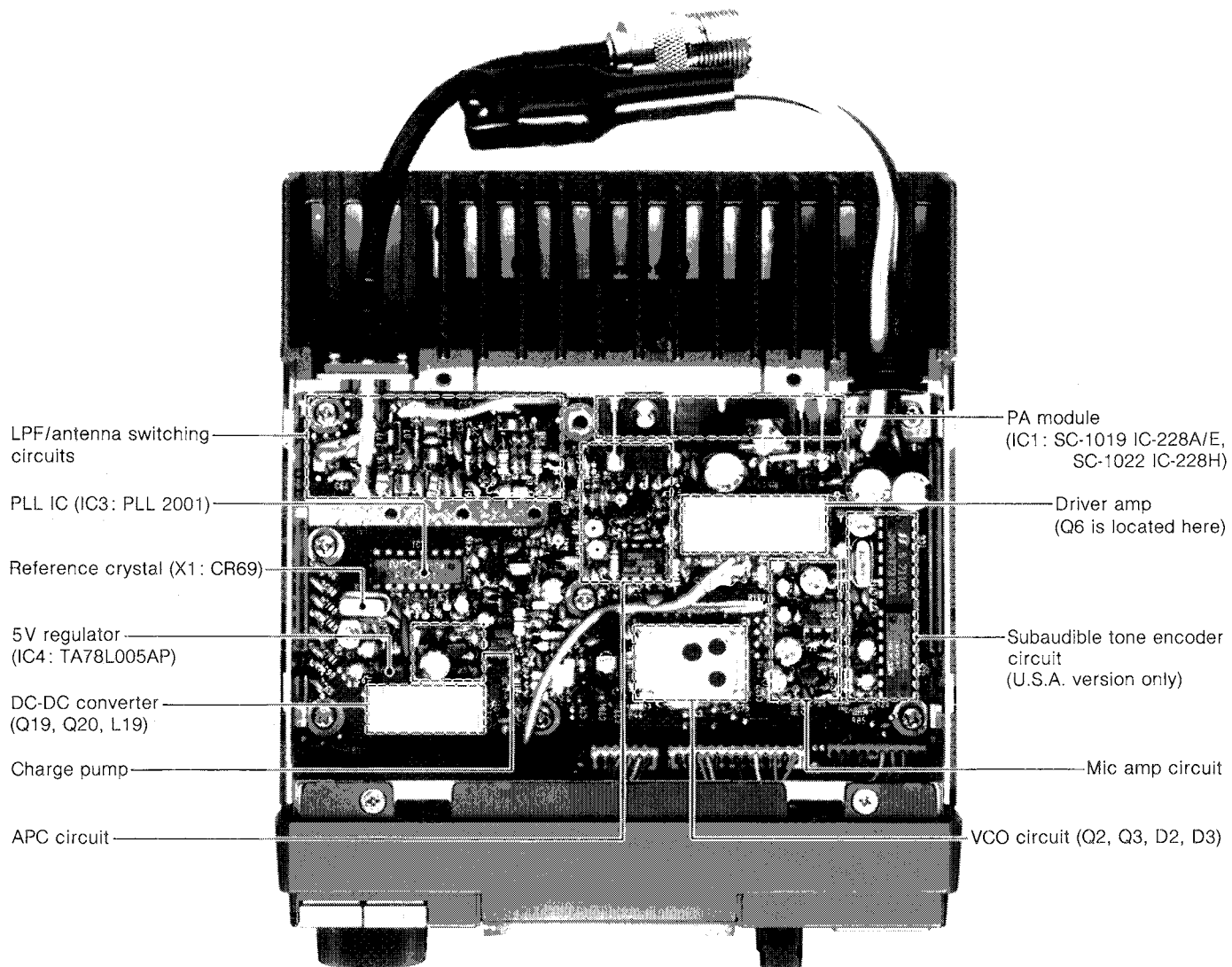


2-3 REAR PANEL

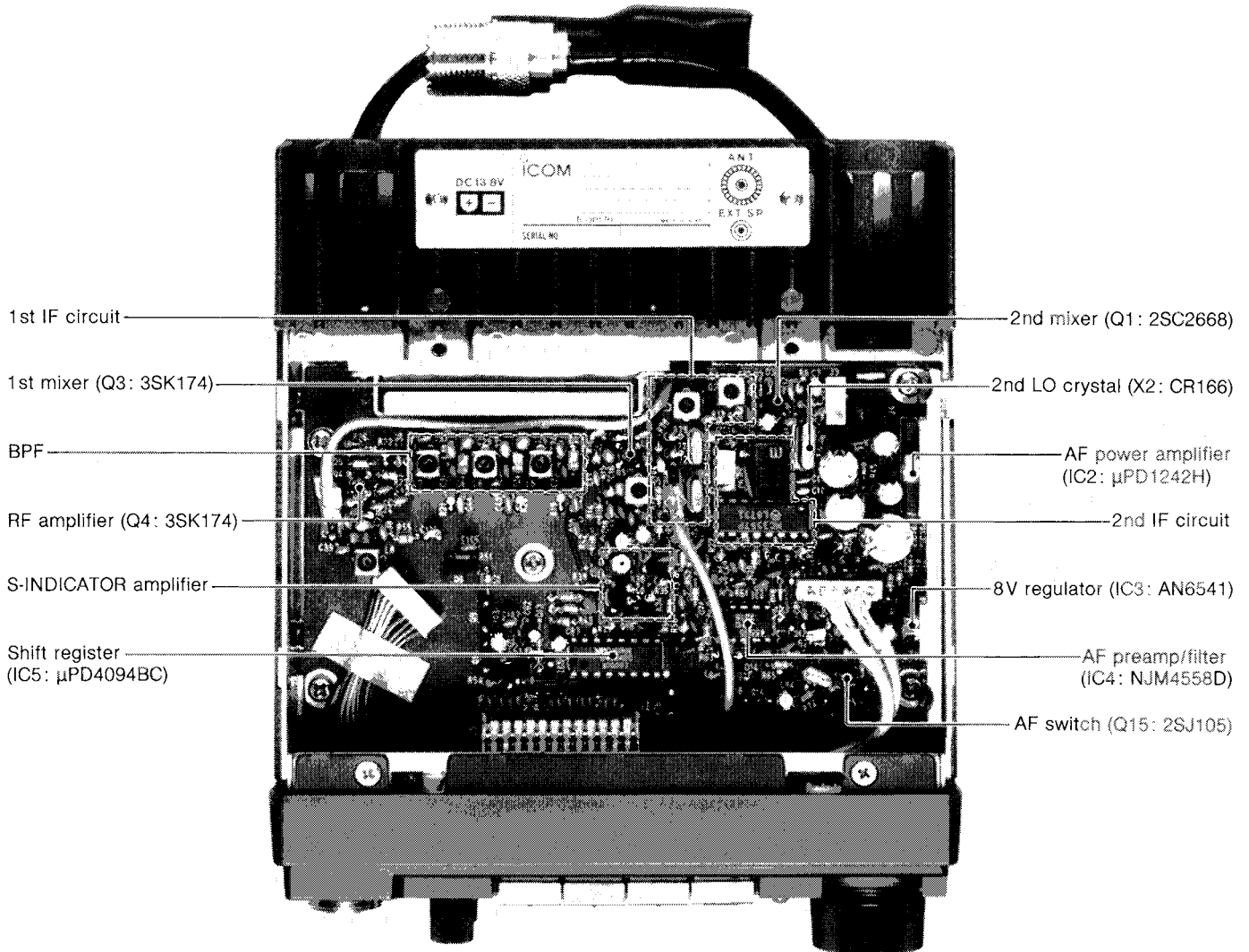
- | |
|-------------------------|
| ① POWER CONNECTOR |
| ② EXTERNAL SPEAKER JACK |
| ③ ANTENNA CONNECTOR |



2-4 MAIN UNIT

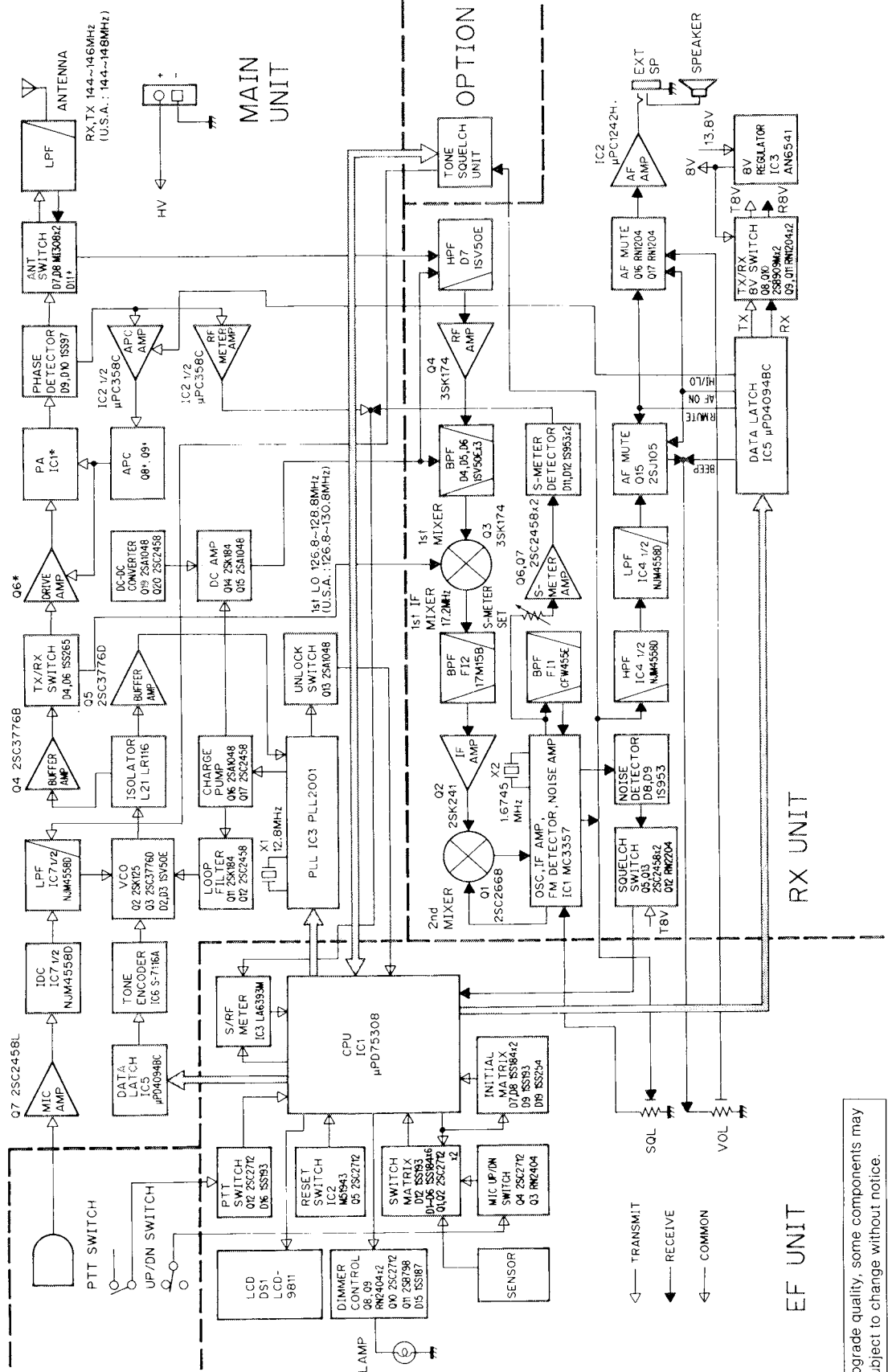


2-5 RX UNIT



SECTION 3 BLOCK DIAGRAM

MODEL	IC1	Q6	Q8	Q9	Q11
IC-228AVE	SC-1019	2SC2407	2SA1359	2SC2458	MI308
IC-228H	SC-1022	TRF559	2SB1019	2SC1645	MI407



To upgrade quality, some components may be subject to change without notice.

SECTION 4 CIRCUIT DESCRIPTION

4-1 RECEIVER CIRCUITS

4-1-1 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

Received signals enter the antenna connector and pass through a low-pass filter (L14~L17, C61~C64), antenna switching circuit (D7, D8, D11) and the other low-pass filter (L12, L13, C57~C59). The signals are applied to the antenna switching circuit (D7, D8, D11) and then to the RX UNIT via coaxial cable P1.

4-1-2 RF CIRCUIT (RX UNIT)

The applied RF signals from the MAIN UNIT are applied to the one-stage bandpass filter (D7, L8, C37), amplified at RF amplifier (Q4), and reapplied to the other bandpass filter (D4~D6, L5~L7, C24, C27, C30) to suppress out-of-band signals.

IF CIRCUIT

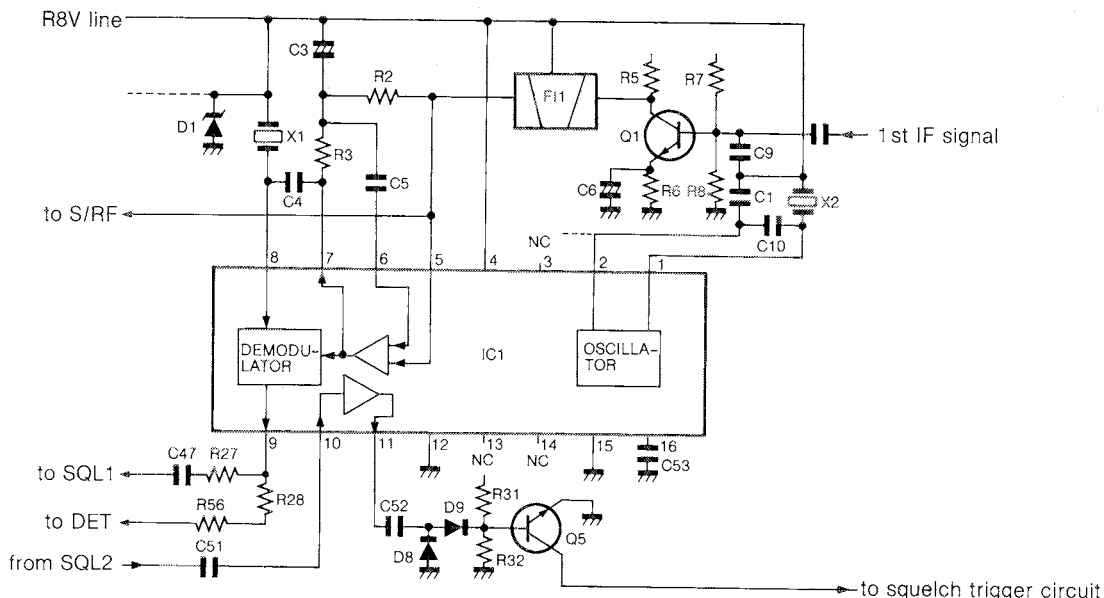


Fig. 1

4-1-3 1ST MIXER CIRCUIT (RX UNIT)

1st mixer circuit Q3 converts the RF signal to the 17.2MHz 1st IF signal. RF signals from the bandpass filter are applied to gate 1 of Q3 and the 1st LO signal (PLL output) is applied to gate 2 of Q3. Q3 mixes this RF signal and a 1st LO signal and outputs 17.2MHz.

4-1-4 1ST IF CIRCUIT (RX UNIT)

The 1st IF signal is applied to a pair of mechanical crystal filters (F12) to suppress out-of-band signals through the matching filter L3 and C16. The signal is then applied to the 2nd IF circuit through amplifier Q2.

D2 and D3 function as the limiter circuit when a strong signal is received.

4-1-5 2ND IF CIRCUITS (RX UNIT)

The 1st IF signal amplified at Q2 is applied to mixer circuit Q1. Q1 mixes the signal with a 16.745MHz 2nd LO signal to convert the 1st IF signal to a 455kHz 2nd IF signal. The converted signal is applied to pin 5 of IC1 through ceramic filter F11.

IC1 contains the 2nd mixer circuit, the 2nd LO circuit and the quadrature detector circuit. X2 generates 16.745MHz for the 2nd LO signal.

Some of the noise components in the detected signal are applied to pin 10 of IC1 through the R2 SQUELCH CONTROL on the front panel. The SQUELCH CONTROL adjusts the noise level.

4-1-6 SQUELCH CIRCUIT (RX UNIT)

Pin 11 of IC1 outputs amplified noise components of frequencies at 20kHz and above. Output signals are rectified by D8 and D9. The rectified voltage triggers the squelch circuit consisting of Q5, Q12 and Q13.

The collector of Q13 outputs the squelch signal and is applied to CPU IC1 in the EF UNIT through the SQL.S line. An output signal of Q12 is applied to analog switch Q15 to control the AF mute circuit.

4-1-7 AF CIRCUIT (MAIN UNIT)

The detected AF signal at pin 9 of IC1 is applied to a two-stage active filter consisting of IC4a and IC4b. The filter functions as a de-emphasis circuit of +6dB/octave as well as a high-pass filter for filtering tone signals for the tone squelch.

A filtered signal is applied to AF amplifier IC2 through analog switch Q15, preamplifier Q16 and Q17 and the VOLUME CONTROL on the front panel.

AF amplifier IC2 amplifies the signal to a sufficient level to drive the speaker.

4-2 TRANSMITTER CIRCUITS

4-2-1 MICROPHONE AMPLIFIER (MAIN UNIT)

An AF signal from the microphone is applied to microphone preamplifier Q7 through the MIC line. IC7b functions as an amplifier as well as a limiter for frequency deviation. IC7b also functions as a pre-emphasis circuit with -6dB/octave characteristics.

4-2-2 MODULATION CIRCUIT (MAIN UNIT)

The signal is filtered by a low-pass filter consisting of IC7a. IC7b has a feedback circuit which functions as a pre-emphasis circuit with $+6\text{dB/octave}$ characteristics. The filtered signal is applied to the VCO circuit for FM modulation.

4-2-3 DRIVE AMPLIFIER (MAIN UNIT)

The VCO output signal is buffer-amplified at Q4, and applied to a switching circuit consisting of D4 and D6.

When transmitting, D4 is turned ON and the amplified signal is applied to pre-driver Q6. Q6 amplifies the signal to 200mW and 400mW for IC-228A/E and IC-228H respectively.

4-2-4 POWER AMPLIFIER (MAIN UNIT)

IC1 is a power amplifier and amplifies the signal to approximately 30W and 50W for IC-228A/E and IC228H respectively. The amplified signal at pin 4 of IC1 is applied to a low-pass filter consisting of L14~L16 and C61~C64 to filter out unwanted out-of-band signals.

4-2-5 ANTENNA SWITCHING CIRCUIT (MAIN UNIT)

When transmitting, a diode switching circuit consisting of D7, D8 and D11 is turned ON by a signal of T9V. Transmit signals are applied to the antenna connector through the low-pass filter.

When receiving, the diode switching circuit is turned OFF and received signals are applied to P1 through a π -type filter consisting of L12, L13 and C57~C59. The filter attenuates unwanted harmonic signals.

4-2-6 APC CIRCUIT (MAIN UNIT)

L11, C44~C49, D9 and D10 forms a mismatching detector circuit.

When the impedance of the connected antenna is matched with 50Ω , detected voltage at D9 and D10 is at a minimum. However the voltage increases when the antenna impedance is not matched with 50Ω .

The detected voltage is applied to pin 2 of IC2a and a reference voltage is applied to pin 3 of IC2a. Pins 2 and 3 form differential inputs and IC3 functions as a differential amplifier. The relation between the detected voltage level and output voltage level at pin 1 of IC3 is an inverse proportion.

If output power from pin 4 of IC1 is increased, detected voltage by D9 and D10 increases. The voltage is applied to pin 2 of IC2a. Pin 1 of the IC2a output level becomes lower than when the output power is normal. The base voltage of Q9 becomes lower and the collector of Q8 also becomes lower. Therefore, applied voltages to the collector of Q6 and pin 2 of IC1 decrease and the output power is controlled at a constant level.

APC CIRCUIT

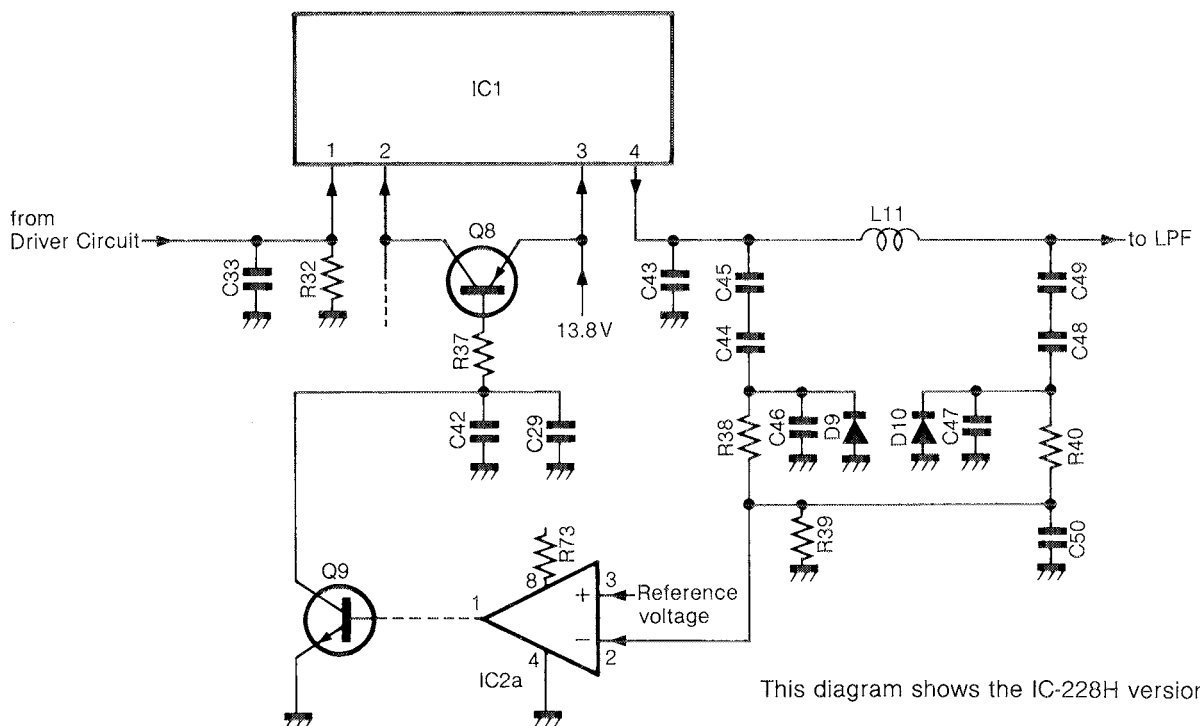


Fig. 2

4-3 PLL CIRCUITS (MAIN UNIT)

4-3-1 GENERAL

IC3 is one package of the PLL IC chip. The IC functions as a phase detector, reference oscillator, fixed divider and programmable divider.

IC3 accepts 200MHz signals directly and divides them without a mixer or prescaler. Therefore an important feature in IC3 is that it generates few spurious components.

The VCO output frequency is set by data signals from IC1 on the EF UNIT.

PLL circuit block diagram

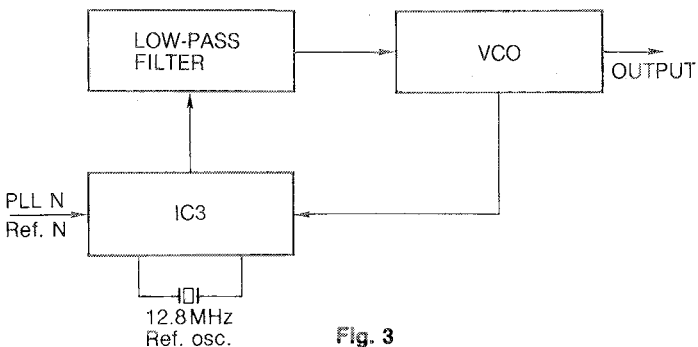


Fig. 3

4-3-2 VCO CIRCUIT

The VCO circuit forms a Hartley oscillator circuit. Q2 oscillates the desired signal and Q3 functions as a buffer amplifier.

The collector of Q3 outputs signals and the signals are applied to an isolator circuit consisting of L21 and R17 for distributing the signals to both the PLL circuit and driver circuit.

R18, R19 and R20 form a 50Ω attenuator. An attenuator is installed between VCO output and the PLL IC chip to reduce reflected waves due to mismatching.

4-3-3 REFERENCE OSCILLATOR

IC3 has an oscillator circuit for the PLL reference frequency signal in the chip. X1 is a crystal unit for oscillating a signal of 12.8MHz. The frequency is divided to either 5kHz or 12.5kHz by data signals from CPU IC1 in the EF UNIT.

4-3-4 CHARGE PUMP AND LOOP FILTER CIRCUITS

Phase-detected signals from pins 5 and 12 are converted to DC voltage by a charge pump circuit consisting of Q16~Q18. The signal is then applied to a low-pass filter circuit consisting of R43~R46 and C75~C78.

Filtered DC voltage is applied to D2 and D3 in the VCO circuit for controlling the VCO output frequency and the gate of Q14 for making voltages for receiver tuning.

4-4 OTHER CIRCUITS

4-4-1 REGULATOR CIRCUITS

IC3 on the RX UNIT is a 3-terminal voltage regulator IC chip. +13.8V is applied to pin 1 and pin 3 outputs +9V. The regulated voltage is applied to each unit.

IC4 on the MAIN UNIT is a 3-terminal voltage regulator IC chip. +13.8V is applied to an input terminal and the output terminal outputs +5V.

Q19 and Q20 form a DC-DC voltage converter for applying approximately 30V DC to the receiver RF circuit.

4-4-2 SUBAUDIBLE TONE ENCODER CIRCUIT (IC-228A: U.S.A. AND ASIA VERSIONS)

IC5 is an IC chip for converting input data from serial to parallel form. The data is sent from IC1 on the EF UNIT. IC6 is an IC chip for generating subaudible tone frequency signals from 67Hz~250.3Hz. The following table shows the relation between input data and the output frequency of IC6.

SUBAUDIBLE TONE ENCODER FREQUENCY TABLE (IC-228A: U.S.A., ASIA VERSIONS)

OUTPUT FREQUENCY [Hz]	IC6 INPUT PIN NUMBER						OUTPUT FREQUENCY [Hz]	IC6 INPUT PIN NUMBER						OUTPUT FREQUENCY [Hz]	IC6 INPUT PIN NUMBER					
	8	9	10	11	12	13		8	9	10	11	12	13		8	9	10	11	12	13
67.0	H	L	L	L	L	L	107.2	L	H	H	H	L	L	167.9	H	H	L	H	H	L
71.9	L	H	L	L	L	L	110.9	H	H	H	H	L	L	173.8	L	L	H	H	H	L
74.4	H	H	L	L	L	L	114.8	L	L	L	L	H	L	179.9	H	L	H	H	H	L
77.0	L	L	H	L	L	L	118.8	H	L	L	L	H	L	186.2	L	H	H	H	H	L
79.7	H	L	H	L	L	L	123.0	L	H	L	L	H	L	192.8	H	H	H	H	H	L
82.5	L	H	H	L	L	L	127.3	H	H	L	L	H	L	203.5	L	L	L	L	L	H
85.4	H	H	H	L	L	L	131.8	L	L	H	L	H	L	210.7	H	L	L	L	L	H
88.5	L	L	L	H	L	L	136.5	H	L	H	L	H	L	218.1	L	H	L	L	L	H
91.5	H	L	L	H	L	L	141.3	L	H	H	L	H	L	225.7	H	H	L	L	L	H
94.8	L	H	L	H	L	L	146.2	H	H	H	L	H	L	233.6	L	L	H	L	L	H
97.4	H	H	L	H	L	L	151.4	L	L	L	H	H	L	241.8	H	L	H	L	L	H
100.0	L	L	H	H	L	L	156.7	H	L	L	H	H	L	250.3	L	H	H	L	L	H
103.5	H	L	H	H	L	L	162.2	L	H	L	H	H	L							

H: HIGH L: LOW

Table 1

4-5 LOGIC CIRCUITS (EF UNIT)

4-5-1 CPU PORT ALLOCATIONS

PORT NUMBER	PIN NUMBER	DESCRIPTION
RESET	68	When a "HIGH" signal is applied here the CPU is initialized or changes to standby mode.
P00 [INT4]	38	Detects a signal for the standby mode of the CPU. The CPU enters the standby mode when the port reads a trailing edge of the signal.
P01 [SCK]	39	Outputs data signals.
P02 [DATA]	40	Outputs serial data synchronized with the SCK signal.
P03 [SQLS]	41	Detects a squelch signal. When the signal is "HIGH," the squelch opens.
P10~P13 [KIR0~KIR3]	42~45	Input ports for the initial matrix.
P20	46	Not used.
P21 [STBRX]	47	Outputs a strobe signal for serial data to the output expander.
P22 [STBPLV]	48	Outputs a strobe signal for serial data to the PLL IC.
P23	49	Not used.
P30 [UNLKV]	50	Detects a PLL unlock signal. When the signal is "HIGH," the PLL is unlocked. Normally the port is "LOW."
P31	51	Not used.
P32 [TXLED]	52	Outputs a signal for turning the TRANSMIT indicator ON and OFF. The port becomes "LOW" and "HIGH" when transmitting and receiving (squelch opens) respectively.
P33 [SRFO]	53	Outputs a reference voltage for the S/R/F indicator.
P40~P43 [KRO~KR3]	29~32	These are input ports for the key matrix.
P50~P53 [KSO~KS3]	34~37	These are output ports for strobe signals for the initial and key matrix.
P60 [SRFI]	60	Inputs a reference voltage for the S/R/F indicator.
P61 [PTT]	61	Inputs a signal on the PTT line. The port should be "HIGH" when the PTT switch is pushed.
P62 [TSQL]	62	Input port for an acknowledge signal in the tone squelch unit. The port is "HIGH" when the tone squelch opens.
P63 [OPT]	63	Input port whether the tone squelch is installed or not. The port is "LOW" when the tone squelch is installed.
P70 [STBOP]	64	Outputs a strobe signal for serial data to the tone squelch unit (MN6520).
P71 [STBCT]	65	Outputs a strobe signal for serial data to the subaudible tone IC (S7116).
P72, P73 [DIM01, DIM02]	66, 67	Outputs a signal for controlling intensity of the FUNCTION DISPLAY. Refer to Table 2.

Table 2

4-5-2 KEY MATRIX

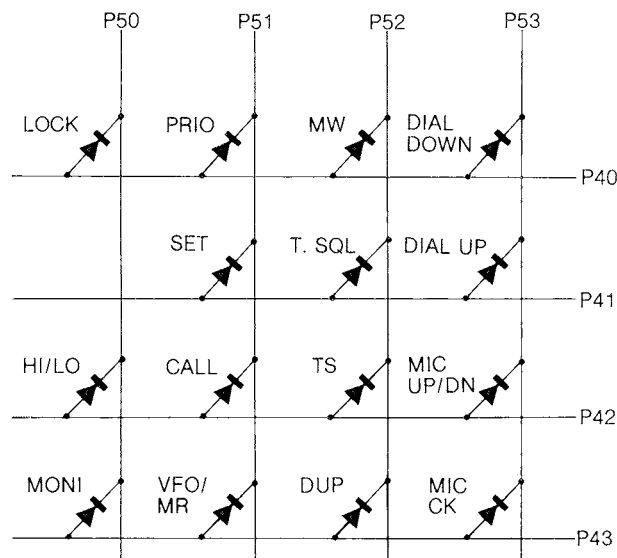


Fig. 4

4-5-3 RESET CIRCUIT

The CPU is reset when the RESET port changes from "HIGH" to "LOW" and then becomes "LOW" again. The

RESET CIRCUIT

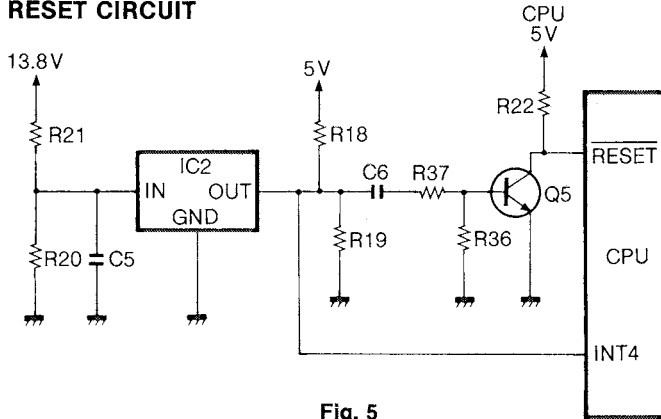


Fig. 5

RESET port remains "HIGH" except when the CPU is reset. The following is a diagram for the reset circuit and timing chart.

RESET TIMING CHART

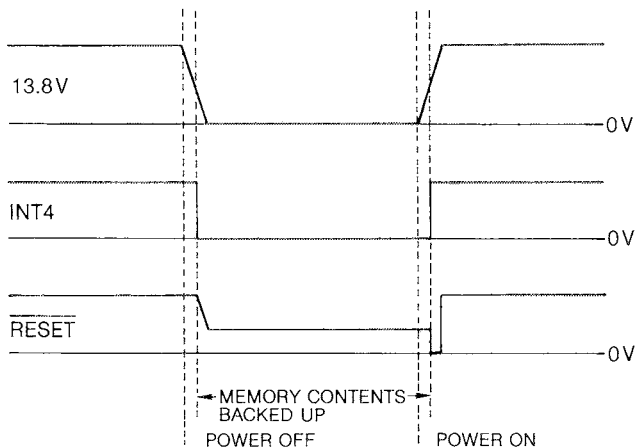


Fig. 6

4-5-4 S/R/F INDICATOR CIRCUIT

IC3 functions as a comparator. Pin 53 of IC1 outputs "HIGH" as a reference voltage to a detected S/R/F signal level.

• Relative signal strength indicator

When receiving, Q6 and Q7 on the RX UNIT amplifies a 455kHz 2nd IF signal. D11 and D12 on the RX UNIT rectify the signal to be converted to DC voltage as the S/R/F signal. The signal is applied to pin 2 of IC3 on the EF UNIT. Pin 1 of IC3 on the EF UNIT outputs "HIGH" when the voltage at pin 3 becomes the same as or higher than the SRF voltage at pin 2. It takes time to output "HIGH" from pin 1 of IC3 after pin 53 of IC1 on the EF UNIT outputs "HIGH". The time depends on the level of the SRF voltage. The higher the level of SRF voltage the longer time it takes. IC1 measures the time and the FUNCTION DISPLAY indicates the relative signal strength.

S/R/F INDICATOR CIRCUIT

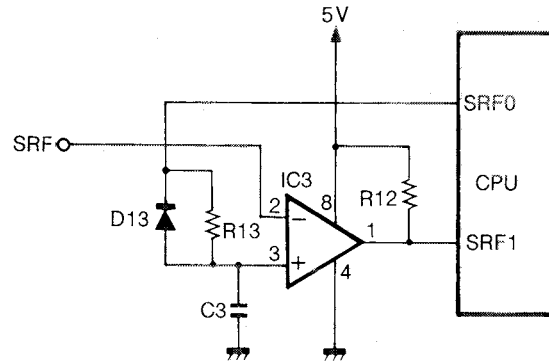


Fig. 7

• RF output power selection indicator

IC2b on the MAIN UNIT amplifies RF output power. The gain of IC2b is set very high, so the output voltage at pin 7 of IC2b is saturated even if the input RF level is small. Then the "HIGH" is applied to pin 2 of IC3 on the EF UNIT. Pin 1 of IC3 is "HIGH" when the power module of IC1 on the MAIN UNIT outputs power. IC1 on the EF UNIT detects either HIGH or LOW output power with the key matrix of P42 and P50.

4-5-5 DIMMER CIRCUIT

The FUNCTION DISPLAY changes its brightness at 4 levels using combinations of output level at P72 and P73. By changing levels at P72 and P73, the base voltage and collector current changes. Therefore, the collector voltage is changed and brightness of lamps DS2~DS4 changes.

DIMMER CIRCUIT

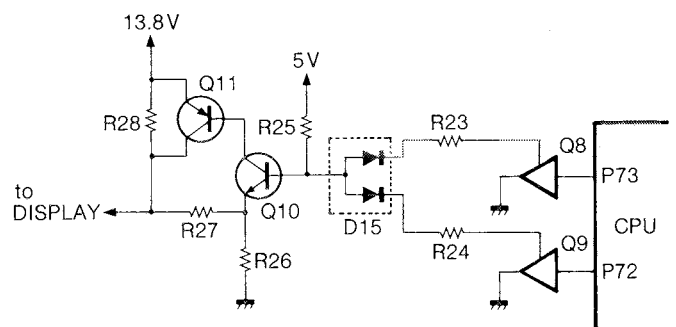


Fig. 8

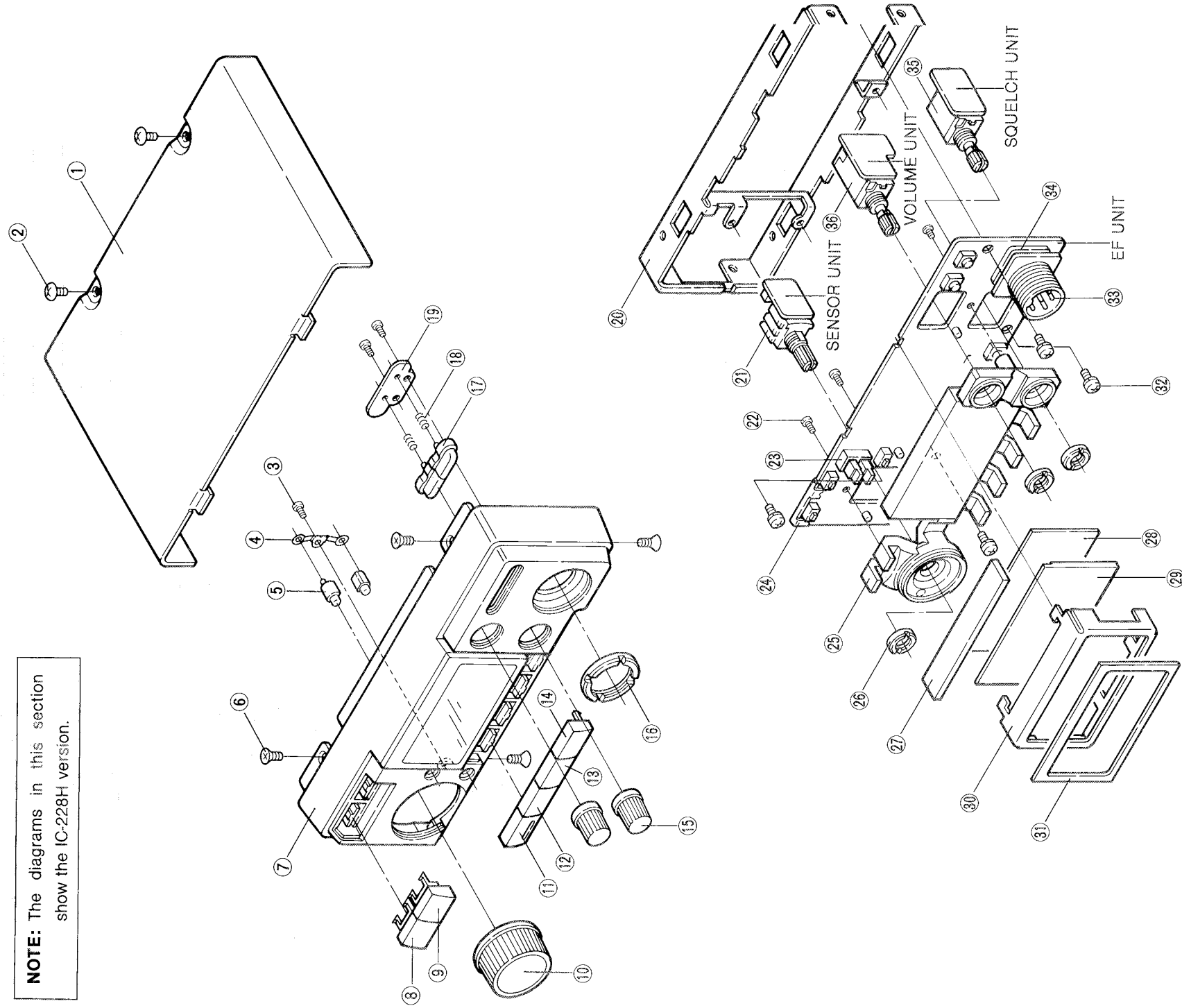
BRIGHTNESS	P72	P73	INDICATION
↑ Brightness ↓ Dark	H	H	d-4
	L	H	d-3
	H	L	d-2
	L	L	d-1

H: HIGH L: LOW

SECTION 5 DISASSEMBLY AND ASSEMBLY DIAGRAMS

5-1 FRONT PANEL DISASSEMBLY

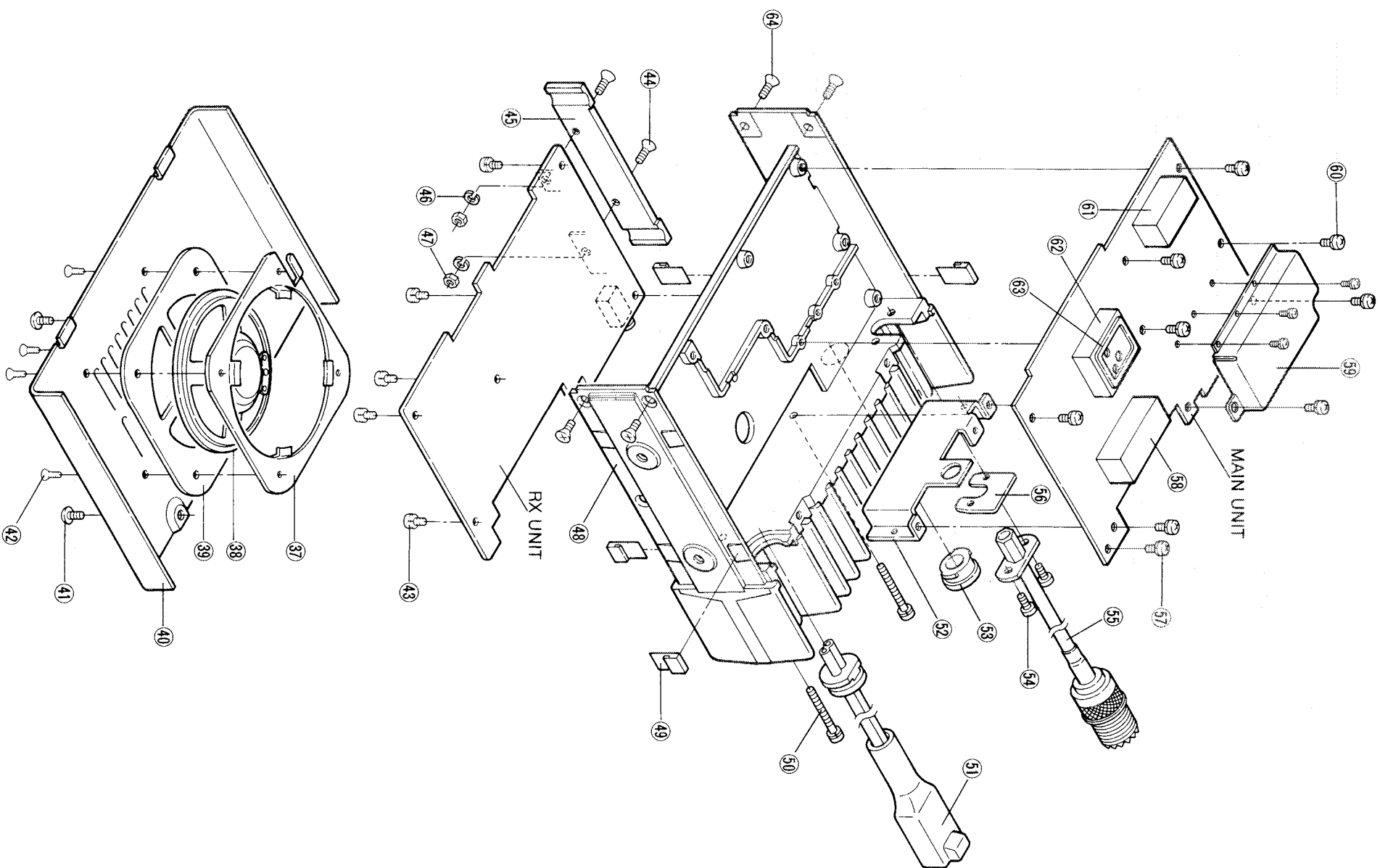
NOTE: The diagrams in this section show the IC-228H version.



LABELLED NUMBER	DESCRIPTION	ORDER NUMBER	QTY.
①	495 Top Cover (A)-1 (IC-228A/E)	8110002130	1
	301 Top Cover (A)-1 (IC-228H)	8110002070	1
②	ICOM Screw (B) 4	8810003700	2
③	PH B0 2 x 5	8810000990	1
④	671 Switch Spring	8930013020	1
⑤	K-113 Button	8610004330	2
⑥	FH M2.6 x 4	8810002100	4
⑦	671 Front Panel (A) (IC-228A)	8210003510	1
	671 Front Panel (A) (IC-228E)	8210003520	1
	671 Front Panel (A) (IC-228H)	8210003360	1
⑧	K-114 Button (E) (VFO/M)	8610004500	1
⑨	K-114 Button (F) (CALL)	8610004510	1
⑩	N-130 Tuning Control Knob	8610004400	1
⑪	K-115 Button (A) (SET)	8610004520	1
⑫	K-114 Button (B) (TS)	8610004360	1
⑬	K-114 Button (D) (PRIO)	8610004380	1
⑭	K-114 Button (C) (HI/LO)	8610004370	1
⑮	N-131 Control Knob	8610004410	2
⑯	Included with ⑮ below	—	—
⑰	K-112 Button	8610004320	2
⑱	Push Spring (H)	8930006450	2
⑲	671 Switch Plate	8930013030	1
⑳	Sub-Chassis	8010007280	1
㉑	Tuning Control SRBM1L038A	2260000860	1
㉒	PH B0 2 x 5	8810000990	3
㉓	LED Spacer	8930012790	1
㉔	671 Grounding Plate	8930013330	1
㉕	671 LCD Reflector	8010007520	1
㉖	VR Nut (E)	8830000550	3
㉗	LCD Contact Strip SRCN543	8930012660	1
㉘	543 LCD Filter	8930012670	1
㉙	LCD 9811J	5030000330	1
㉚	543 LCD Holder-1	8930012681	1
㉛	671 LCD Rubber	8930013420	1
㉜	Set Screw (A) 2.6 x 5	8810003960	4
㉝	Mic Connector Assembly 8S-S-E	6510000290	1
㉞	543 Mic Spacer	8930012430	1
㉟	SQUELCH CONTROL RK0971114005A	7210001490	1
㊱	VOLUME CONTROL RK097111200BA	7210001480	1

Screw type Screw: M2.6 x 4, etc. Self-tapping screw: B0 2 x 4, etc.
Screw's head style PH: Pan head FH: Flat head

5-2 FRAME DISASSEMBLY

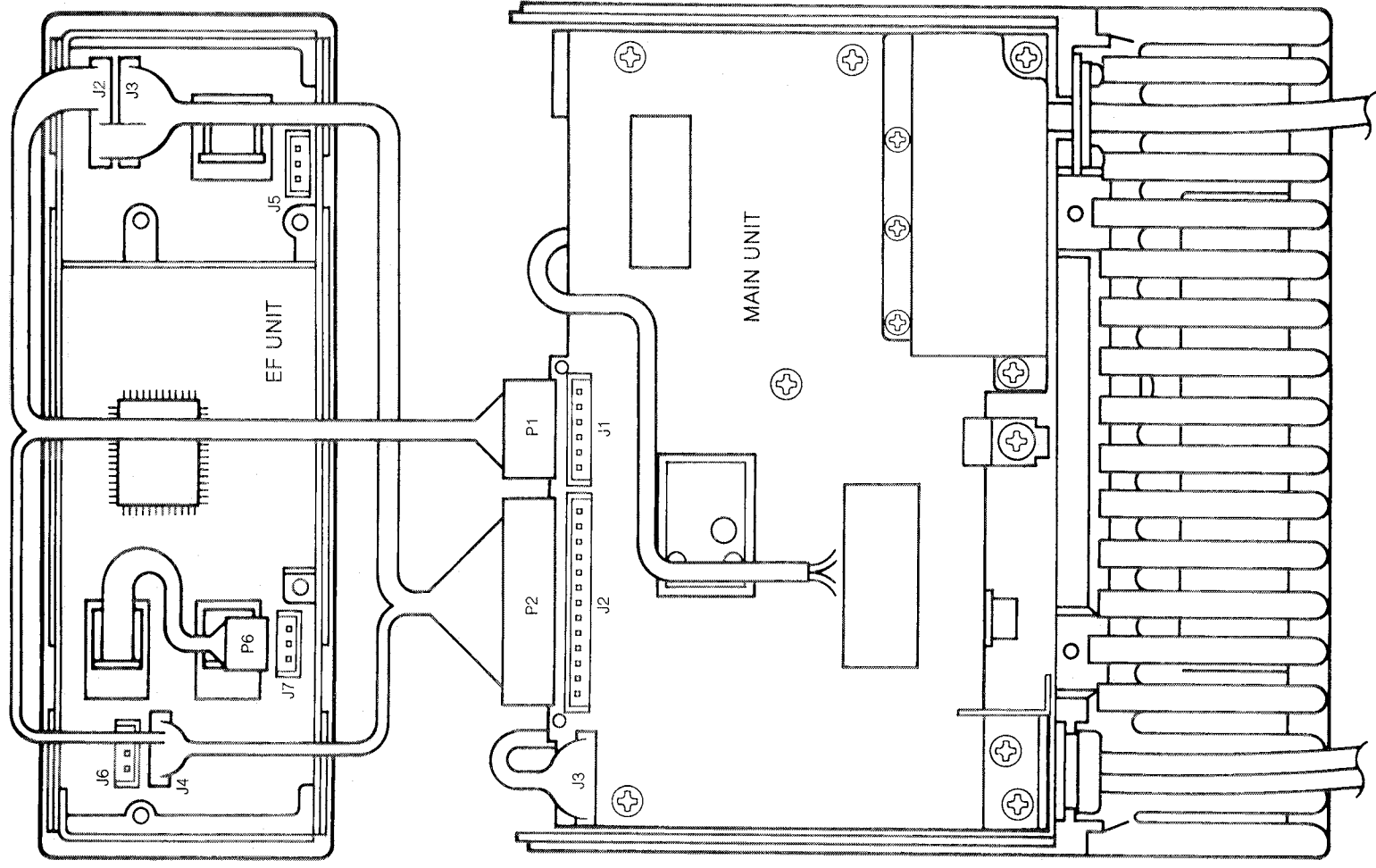


LABELLED NUMBER	DESCRIPTION	ORDER NUMBER	QTY.
37	57 Speaker Holder	8930002650	1
38	Speaker 57S38-1	2510000280	1
39	57 Speaker Spacer	8930004950	1
40	495 Bottom Cover (B)-1 (IC-228A/E) 301 Bottom Cover (B)-1 (IC-228H)	8110002140 8110002080	1 1
41	ICOM Screw (B) 4	8810003700	2
42	FH M2.6 x 5 ZK	8810002450	4
43	Set Screw (A) 3 x 5	8810003150	5
44	FH M3 x 8	8810002180	2
45	AF Heatsink (A)	8410000980	1
46	Spring Washer M3 Ni	8850000420	2
47	Nut M3	8830000100	2
48	470 Chassis (A)-3 (IC-228A/E) 301 Chassis (A)-4 (IC-228H)	8110007511 8010007431	1 1
49	Cover Slider	8930000820	4
50	ICOM Screw (A) 12 (IC-228A/E) Set Screw (A) 3 x 18 (IC-228H)	8810004030 8810003230	2 2
51	Power Supply Cable OPC-143 (Connector included)	8900001520	1
52	Module Shield Plate	8510003450	1
53	Rubber Bushing	8930007860	1
54	PH M3 x 6 BSBM Ni	8810001910	2
55	Antenna Cable OPC-186 (Connector included)	8900001890	1
56	Antenna Plate	8930009080	1
57	Set Screw (A) 3 x 5	8810003150	9
58	Mixer Shield Case	8510000470	1
59	Filter Shield Case	8510003070	1
60	Set Screw (A) 2.6 x 5	8810003960	3
61	Mixer Shield Case	8510002020	1
62	VCO Case (A)	8510002210	1
63	VCO Top Cover (A)	8510002250	1
64	FH M3 x 5	8810002160	4

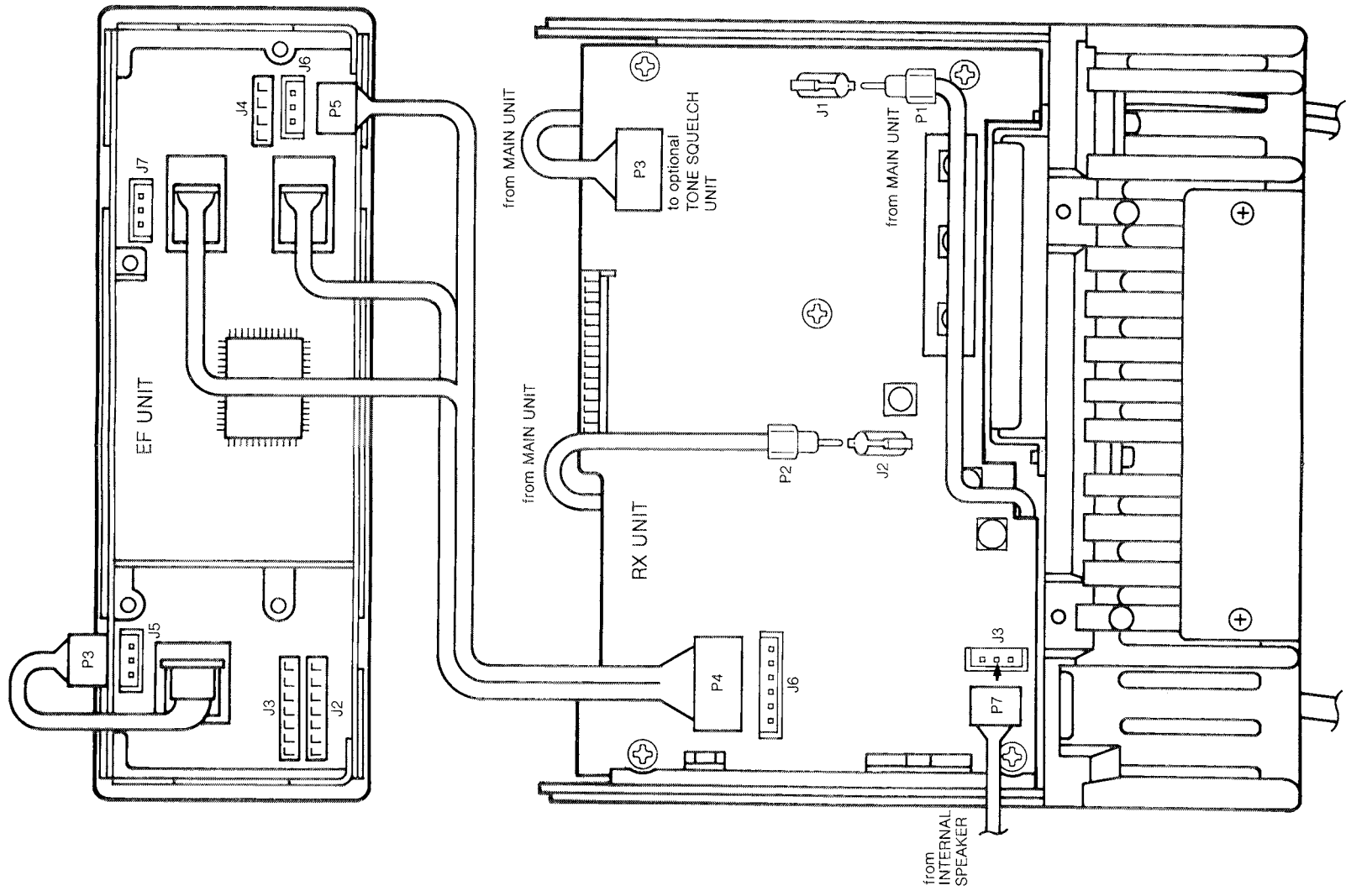
Screw type Screw: M2.6 x 4, etc. Self-tapping screw: B0 2 x 4, etc.

Screw's head style PH: Pan head FH: Flat head

5-3 MAIN UNIT CONNECTOR ASSEMBLY



5-4 RX UNIT CONNECTOR ASSEMBLY



SECTION 6 MAINTENANCE AND ADJUSTMENT

6-1 PREPARATION BEFORE SERVICING

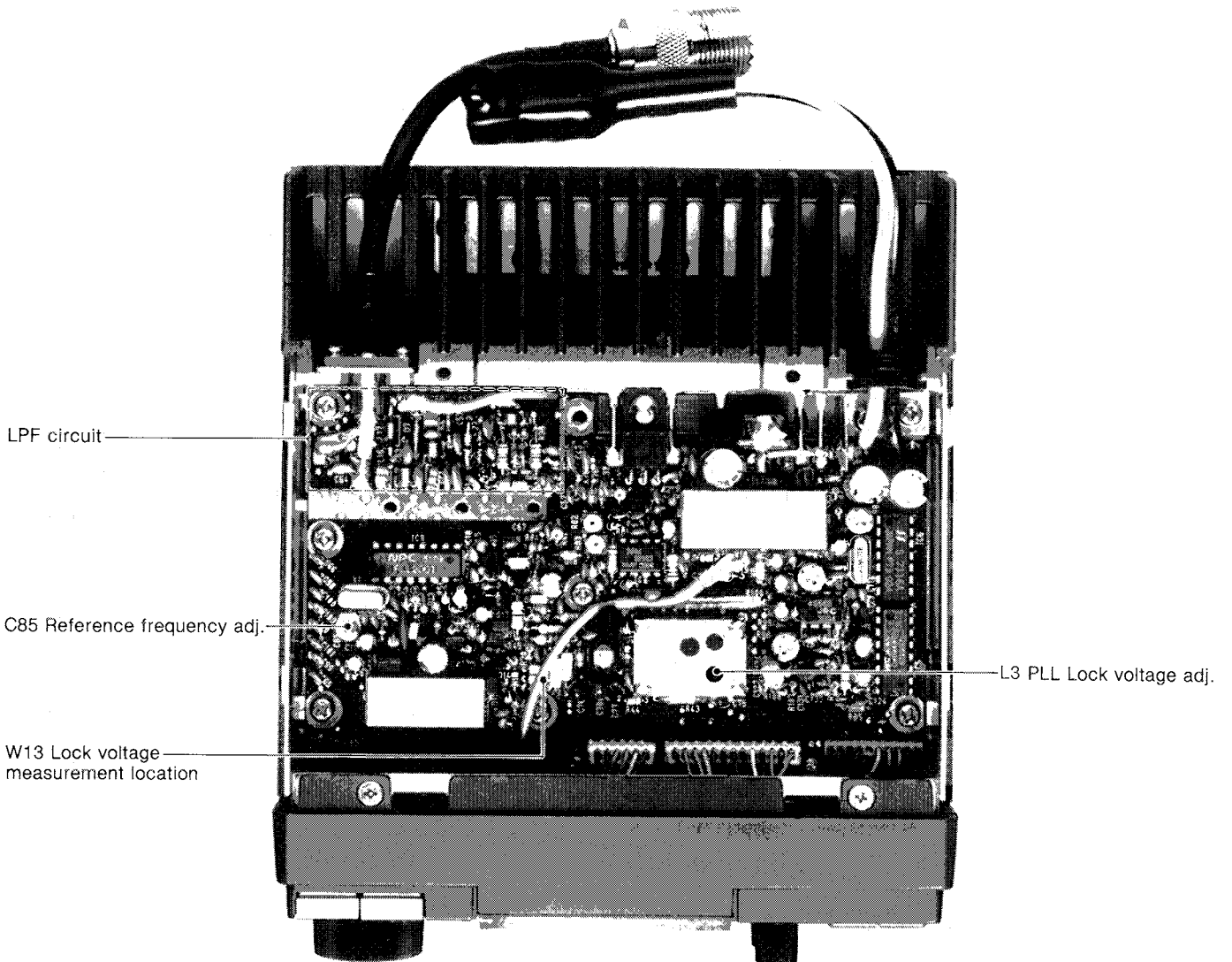
1. Detach the power cord and turn OFF the POWER SWITCH before performing any work on the transceiver.
2. DO NOT force any of the variable components. Turn them slowly and smoothly.
3. Follow the instructions exactly. If an indicated result is not obtained, repeat the instruction until the correct result is obtained.
4. Confirm defective operation of the transceiver first when checking an out-of-service unit. Verify that external sources DO NOT cause the problem.
5. Remove the transceiver case as shown in SECTION 5-1.
6. For transmission problems, attach a dummy load to the ANTENNA CONNECTOR. For reception problems, attach an antenna or signal generator to the ANTENNA CONNECTOR. DO NOT transmit into the signal generator.
7. Re-check for the suspected malfunction with the POWER SWITCH ON.
8. There are different versions of this transceiver. Adjustment procedures and results may differ for each version. Be sure to follow the correct procedure for the transceiver you adjust.

6-2 PLL ADJUSTMENT

ADJUSTMENT		ADJUSTMENT CONDITIONS		MEASUREMENT		ADJUSTMENT POINT	
				UNIT	LOCATION	UNIT	ADJUST
LOCK VOLTAGE	1	<ul style="list-style-type: none"> • Frequency display: 145,000MHz 	MAIN	Connect the DC voltmeter to W13.	8 V	MAIN (VCO)	L3
REFERENCE FREQUENCY	1	<ul style="list-style-type: none"> • Frequency display: 145,000 MHz • Transmitting 	MAIN	Loose couple the frequency counter to the LPF circuit.	145,000MHz	MAIN	C85

TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> • Output voltage : 13.8 V DC \pm 15% • Current capacity : 10A or more <p>(2) DC VOLTMETER</p> <ul style="list-style-type: none"> • Input impedance : 50KΩ/V DC or better <p>(3) FREQUENCY COUNTER</p> <ul style="list-style-type: none"> • Frequency minimum : 150MHz • Frequency accuracy : 1ppm or better • Sensitivity : 100mV or better <p>(4) RF POWER METER (or 50Ω dummy load)</p> <ul style="list-style-type: none"> • Minimum power rating: 100W • Frequency minimum : 150MHz • Input impedance : 50Ω • SWR : 1.2:1 or better 	

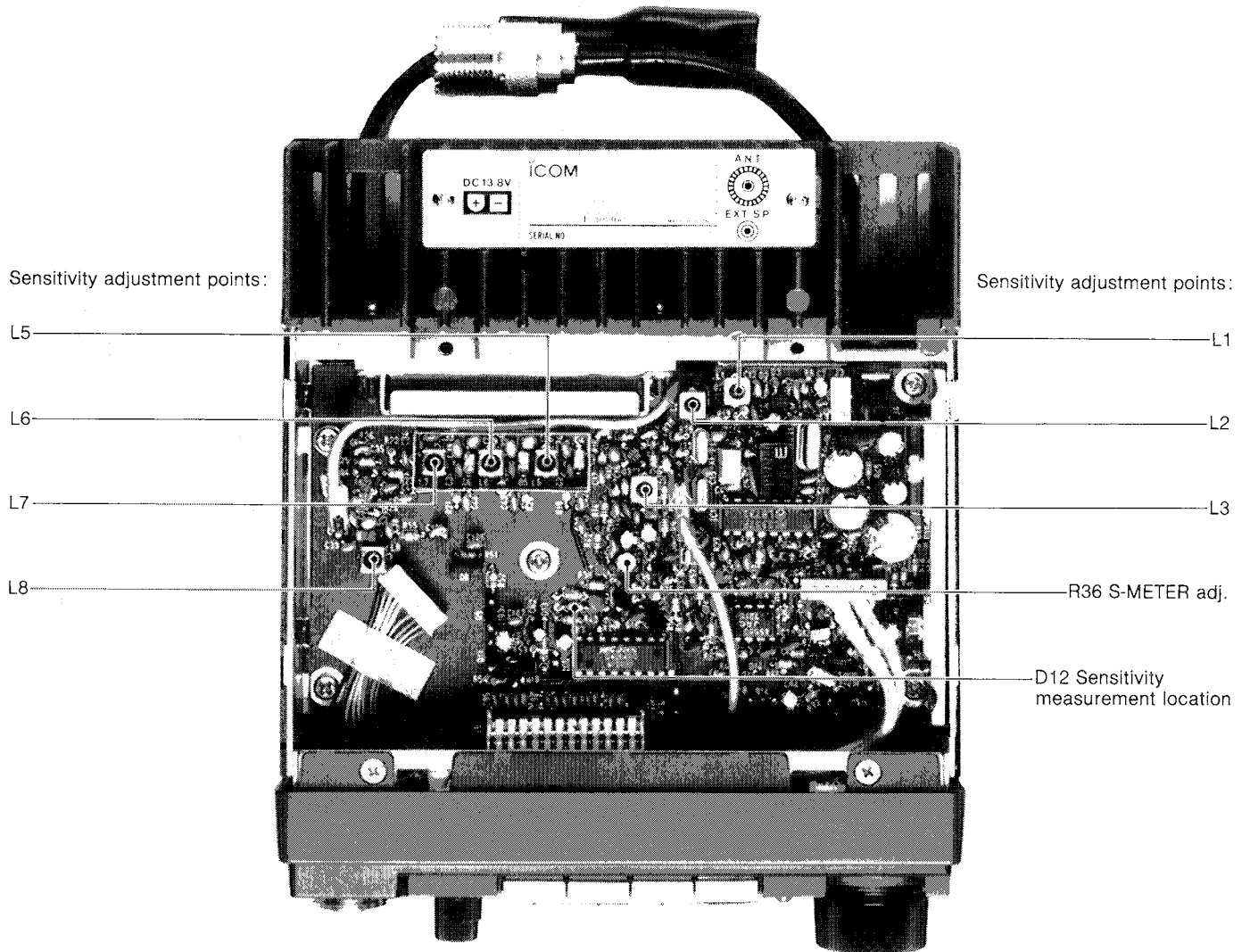
MAIN UNIT



6-3 RECEIVER ADJUSTMENT

TEST INSTRUMENTS REQUIRED		MEASUREMENT CONNECTION LOCATION					
(1) AC POWER SUPPLY <ul style="list-style-type: none"> • Output voltage : 13.8V DC\pm15% • Current capacity : 10A or more (2) STANDARD SIGNAL GENERATOR <ul style="list-style-type: none"> • Frequency range : 0.1~180MHz • Output level : -127~-17dBm (0.1μV~32mV) (3) DC VOLTMETER <ul style="list-style-type: none"> • Input impedance : 50kΩ/V DC or better 							
ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT		
		UNIT	LOCATION		UNIT	ADJUST	
SENSITIVITY	1	RX	Connect the DC voltmeter to the cathode of D12.	Maximum	RX	Adjust in sequence L8 L7 L6 L5 Repeat above adjustments 2 or 3 times.	
	2					L3 L2 L1	
NOTE: Adjust the signal generator output each time until the DC voltmeter is at 30% on the full scale reading of the lowest range.							
S-METER	1	FUNCTION DISPLAY	S/RF INDICATOR	S3 (2 dots)	RX	R36	

RX UNIT



6-4 TRANSMITTER ADJUSTMENT

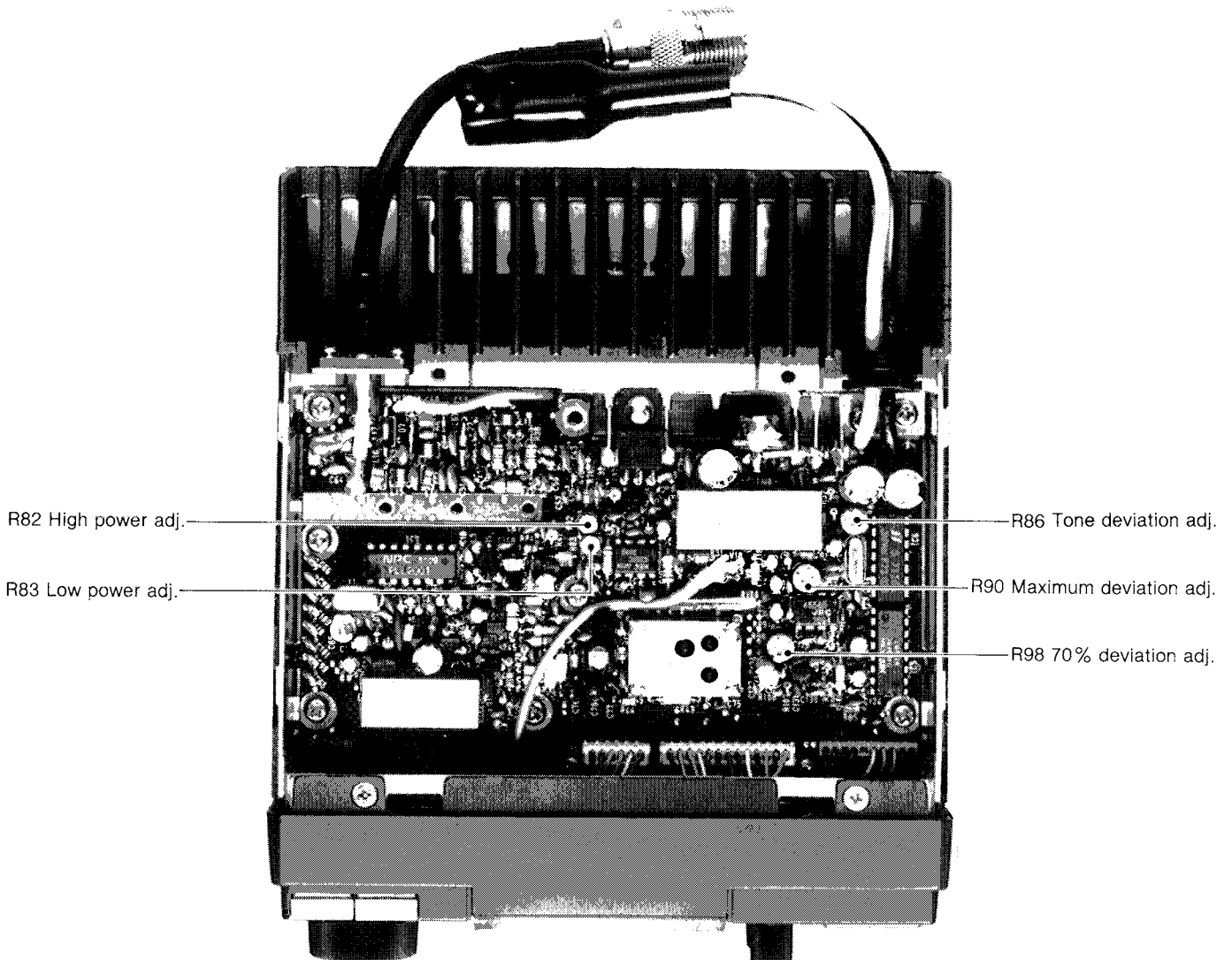
TEST INSTRUMENTS REQUIRED	MEASUREMENT CONNECTION LOCATION
<p>(1) AC POWER SUPPLY</p> <ul style="list-style-type: none"> • Output voltage : 13.8V DC\pm15% • Current capacity : 10A or more <p>(2) RF POWER METER</p> <ul style="list-style-type: none"> • Terminated type • Minimum power rating: 50W • Frequency minimum : 150MHz • Input impedance : 50Ω • SWR : 1.2 : 1 or better <p>(3) FM DEVIATION METER</p> <ul style="list-style-type: none"> • Frequency minimum : 150MHz • Measuring range : 0$\sim$$\pm$10kHz <p>(4) AF GENERATOR</p> <ul style="list-style-type: none"> • Frequency range : 200\sim2000Hz • Output range : 2\sim200mV <p>(5) ATTENUATOR</p> <ul style="list-style-type: none"> • Attenuation : 40dB or 50dB • Input power rating : At least 50W 	<p>The diagram illustrates the measurement setup for the transmitter. It shows a central 'MAIN UNIT' (IC-228A/E/H) with an antenna connector on top. An 'RF POWER METER' is connected to the antenna connector via an 'ATTENUATOR'. An 'FM DEVIATION METER' is also connected to the antenna connector. An 'AC POWER SUPPLY' is connected to the main unit. An 'AF GENERATOR' is connected to the 'MIC CONNECTOR' on the side of the main unit. The 'MIC CONNECTOR' is also connected to 'MIC', 'MIC GND', and 'PTT SWITCH' terminals.</p>

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
OUTPUT POWER	1	Rear panel	Connect the RF power meter to the ANTENNA CONNECTOR.	25W (IC-228A/E) 45W (IC-228H)	MAIN	R82
	2			5W (Any model)		R83
DEVIATION	1	Rear panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	\pm 4.8kHz	MAIN	R90
	2			\pm 3.5kHz		R98

TRANSMITTER ADJUSTMENT (CONTINUED)

ADJUSTMENT	ADJUSTMENT CONDITIONS	MEASUREMENT		VALUE	ADJUSTMENT POINT	
		UNIT	LOCATION		UNIT	ADJUST
TONE DEVIATION (IC-228A/H U.S.A., Asia only)	1 <ul style="list-style-type: none"> • Frequency display: 146.000 MHz • Apply no signal to the MIC CONNECTOR. • [T/T. SQL] SWITCH: ON • Tone frequency: 88.5 kHz • Set the FM deviation meter. HPF: OFF LPF: 20 kHz 	Rear panel	Connect the FM deviation meter to the ANTENNA CONNECTOR via the attenuator.	±0.85 kHz	MAIN	R86
POWER MODULE INPUT (For repair reference)	1 <ul style="list-style-type: none"> • Frequency display: 145.000 MHz • Remove solder and disconnect IC1 pin 1 from MAIN UNIT. • Transmitting 	MAIN	Connect the RF power meter (1 W type) to the point where solder is removed.	More than +26 dBm (400 mW) (IC-228H) More than +23 dBm (200 mW) (IC-228A/E)		Verify

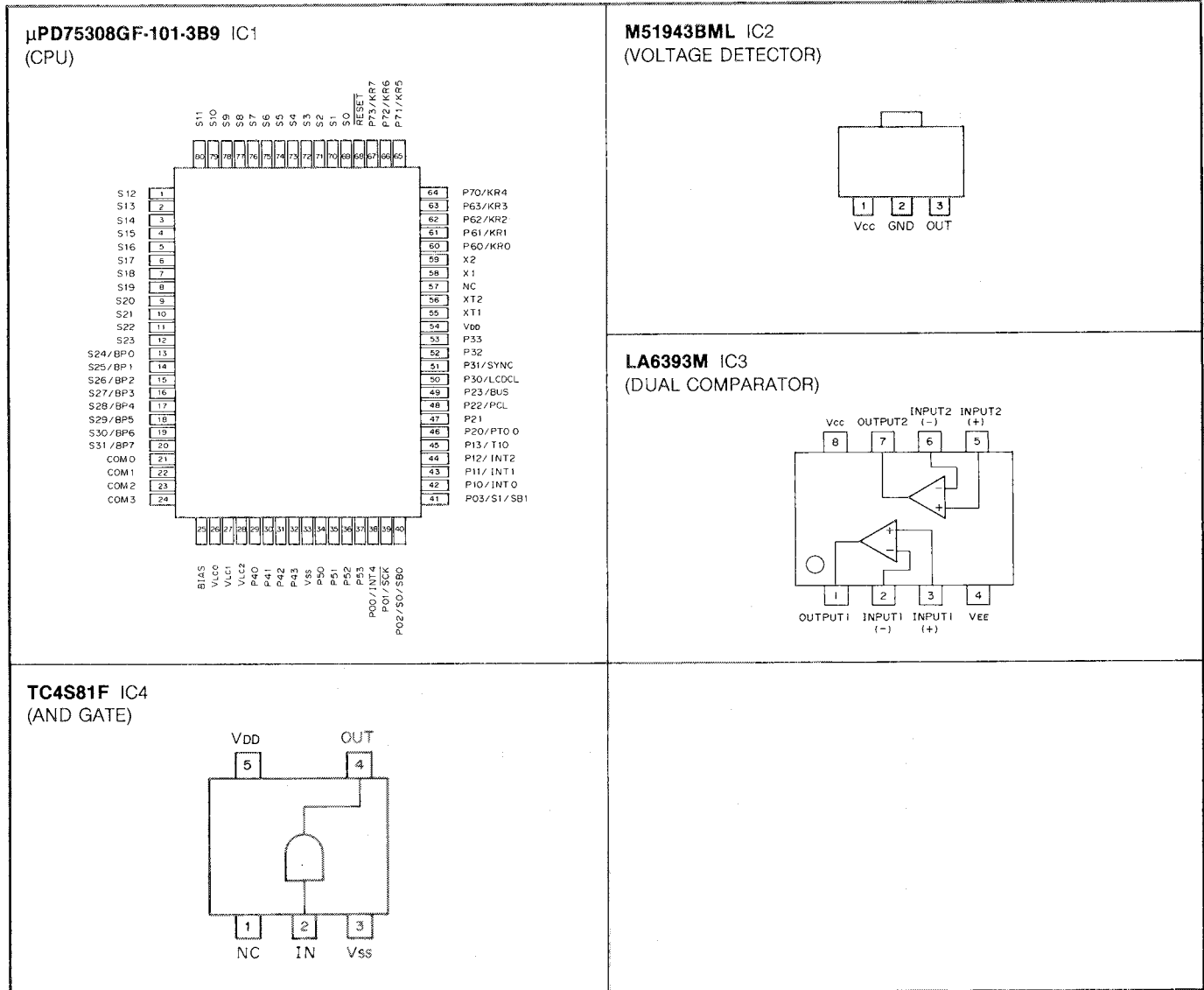
MAIN UNIT



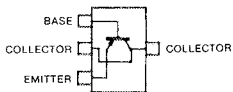
SECTION 7 BOARD LAYOUTS

7-1 EF UNIT

• EF UNIT

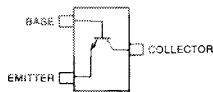


2SB798 DK
Q11



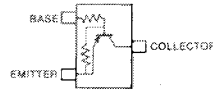
Symbol: DK

2SC2712 Y
Q1, Q2, Q4
Q5, Q10, Q12
Q14, Q15



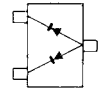
Symbol: LY

RN2404
Q3, Q8
Q9, Q13



Symbol: YD

1SS181
D15, D17



Symbol: A3

1SS184
D1, D2, D3
D4, D5, D6
D8 (IC-228E/H Italy)
D11, D14



Symbol: B3

1SS193
D8 (IC-228A/H Australia)
D9 (IC-228E/H Germany, Italy)
IC-228A/H Australia)
D12, D13
D16



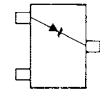
Symbol: F3

1SS196
D7 (IC-228A/H U.S.A., Australia)
D8 (IC-228/H Germany)



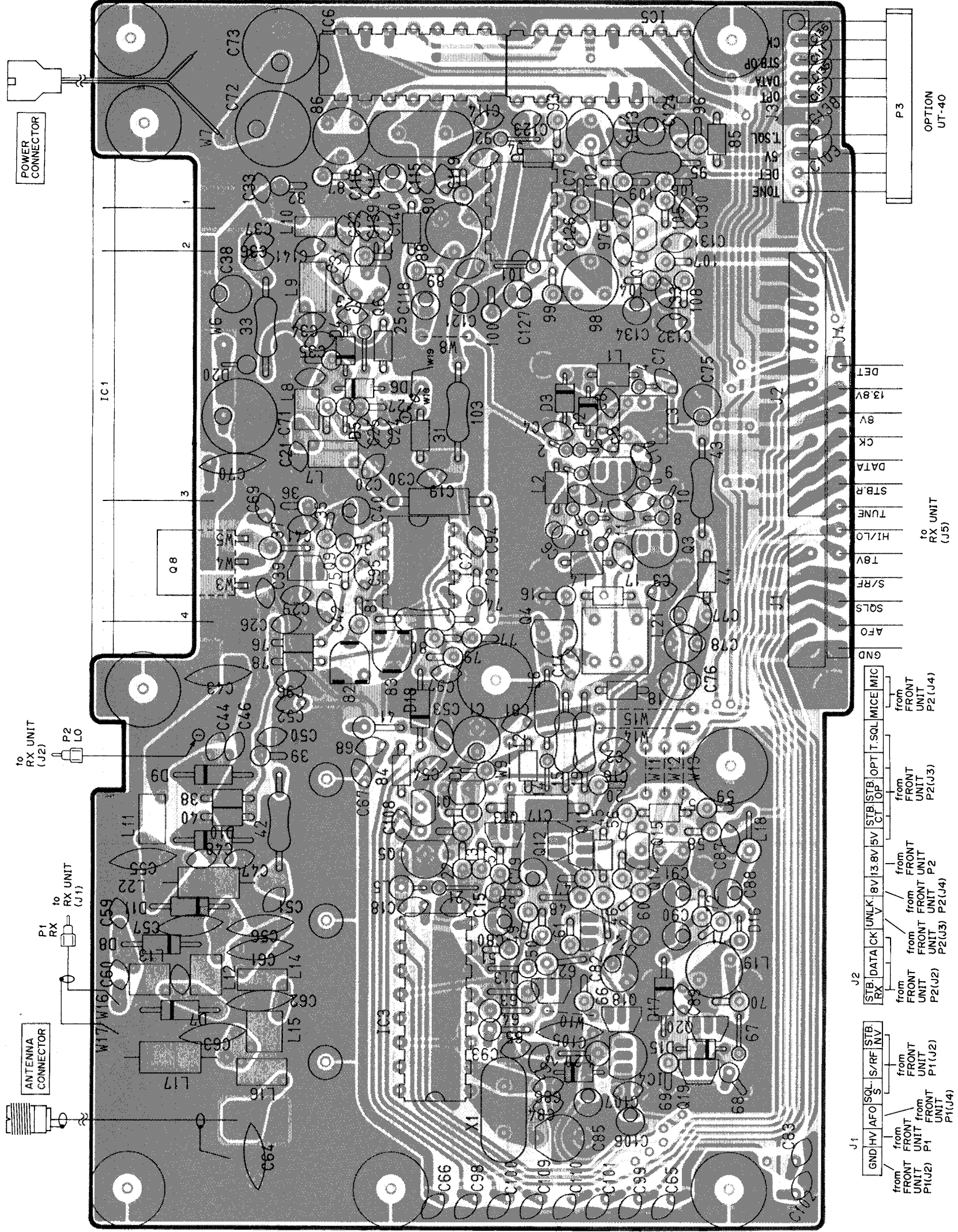
Symbol: G3

RD9.1M B2
D18



Symbol: 912

• MAIN UNIT (IC-228A/E)



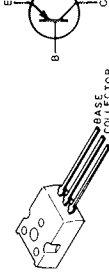
2SA1048 GR
Q13, Q15
Q16, Q19



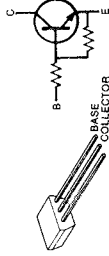
2SC3776 D
Q3, Q4
Q5



2SA1359 Y
Q8



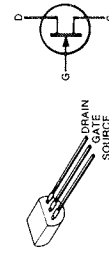
RN1204
Q10



2SC2407
Q6



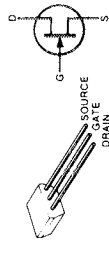
2SK125
Q2



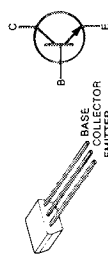
2SC2458 GR
Q1, Q9
Q12, Q17
Q18, Q20



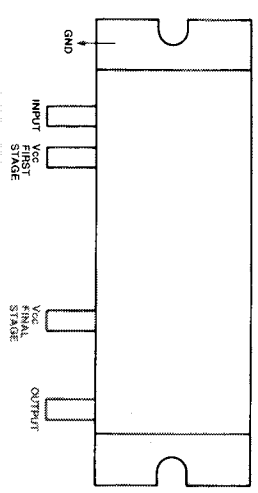
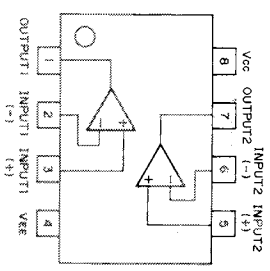
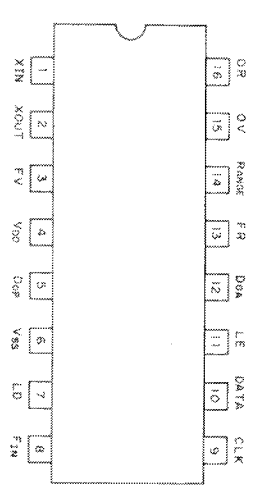
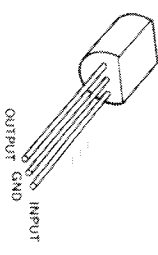
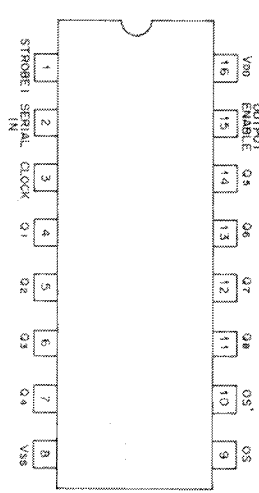
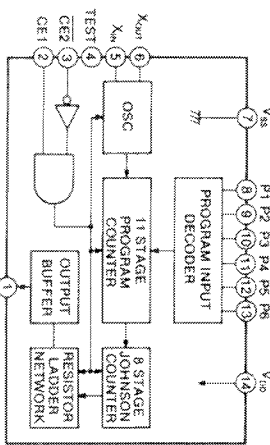
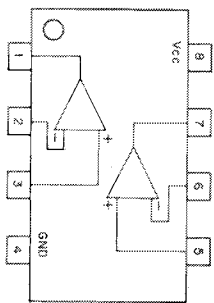
2SK184 Y
Q11, Q14



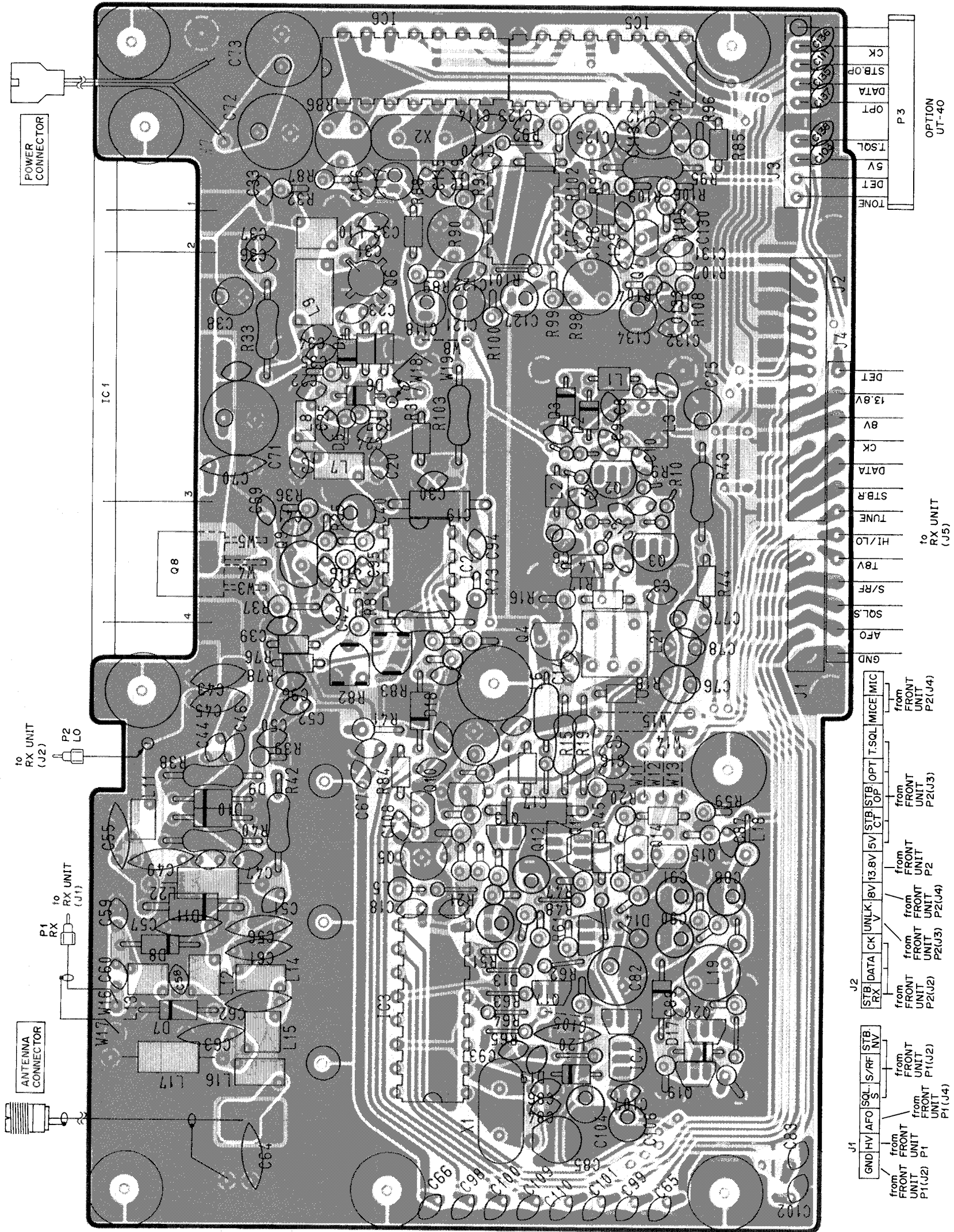
2SC2458L G
Q7



• IC-228H

<p>SC-1022 IC1 (45W VHF RF POWER AMP)</p> 	<p>μPC358C IC2 (DUAL DRIVER)</p> 
<p>PLL2001 IC3 (PLL IC)</p> 	<p>TAT8L005AP IC4 (3-TERMINAL 5V REGULATOR)</p> 
<p>μPDA094BC (IC-228H: U.S.A., Asia) IC5 (8-STAGE SHIFT REGISTER)</p> 	<p>S7116A (IC-228H: U.S.A., Asia) IC6 (PROGRAMMABLE TONE GENERATOR)</p> 
<p>NUM4558D IC7 (DUAL NOISE LOW AMP)</p> 	

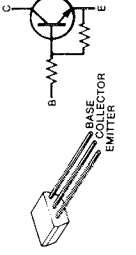
• MAIN UNIT (IC-228H)



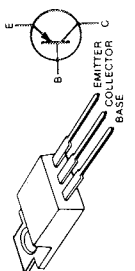
2SA1048 GR
Q13, Q15
Q16, Q19



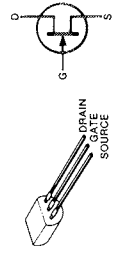
RN1204
Q10



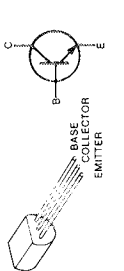
2SB1019
Q8



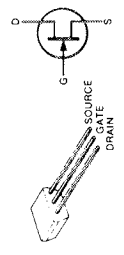
2SK125
Q2



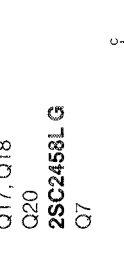
2SC1645 B
Q9



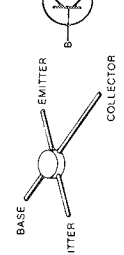
2SK184 Y
Q11, Q14



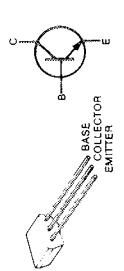
2SC2458 GR
Q1, Q12
Q17, Q18
Q20



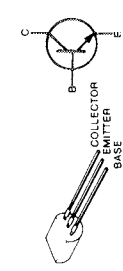
TRF559
Q6



2SC2458L G
Q7

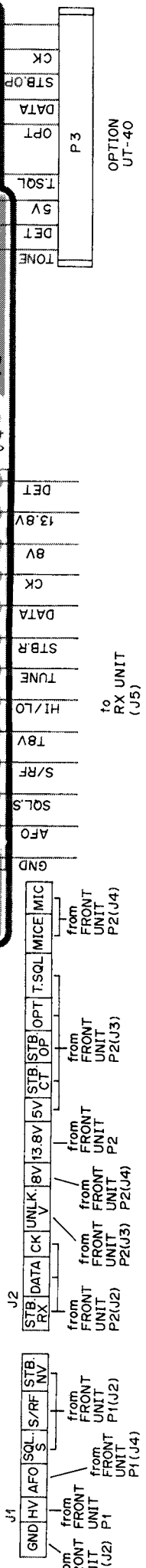


2SC3776 D
Q3, Q4
Q5



POWER CONNECTOR

ANTENNA CONNECTOR

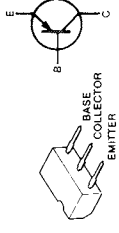


7-3 RX UNIT

<p>MC3357P IC1 (NARROW BAND FM IF)</p>	<p>µPC1242H IC2 (AUDIO POWER AMP)</p>
<p>AN6541 IC3 (3-TERMINAL POSITIVE VOLTAGE REGULATOR)</p>	<p>NJM4558D IC4 (DUAL NOISE LOW AMP)</p>
<p>µPD4094BC IC5 (8-STAGE SHIFT REGISTER)</p>	

• RX UNIT

2SB909M Q/R
Q8, Q10



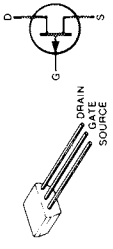
RN2204
Q12, Q18



2SC2458 GR
Q5, Q6
Q7, Q13



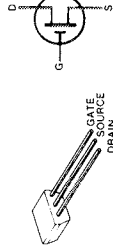
2SJ105 GR
Q15



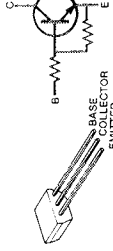
2SC2668 O
Q1



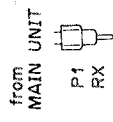
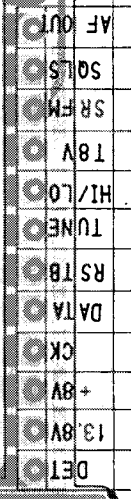
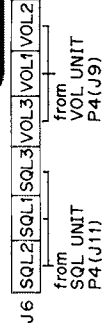
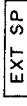
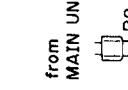
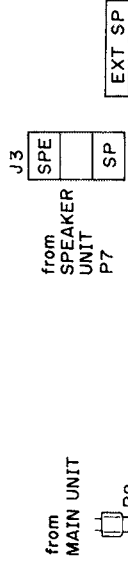
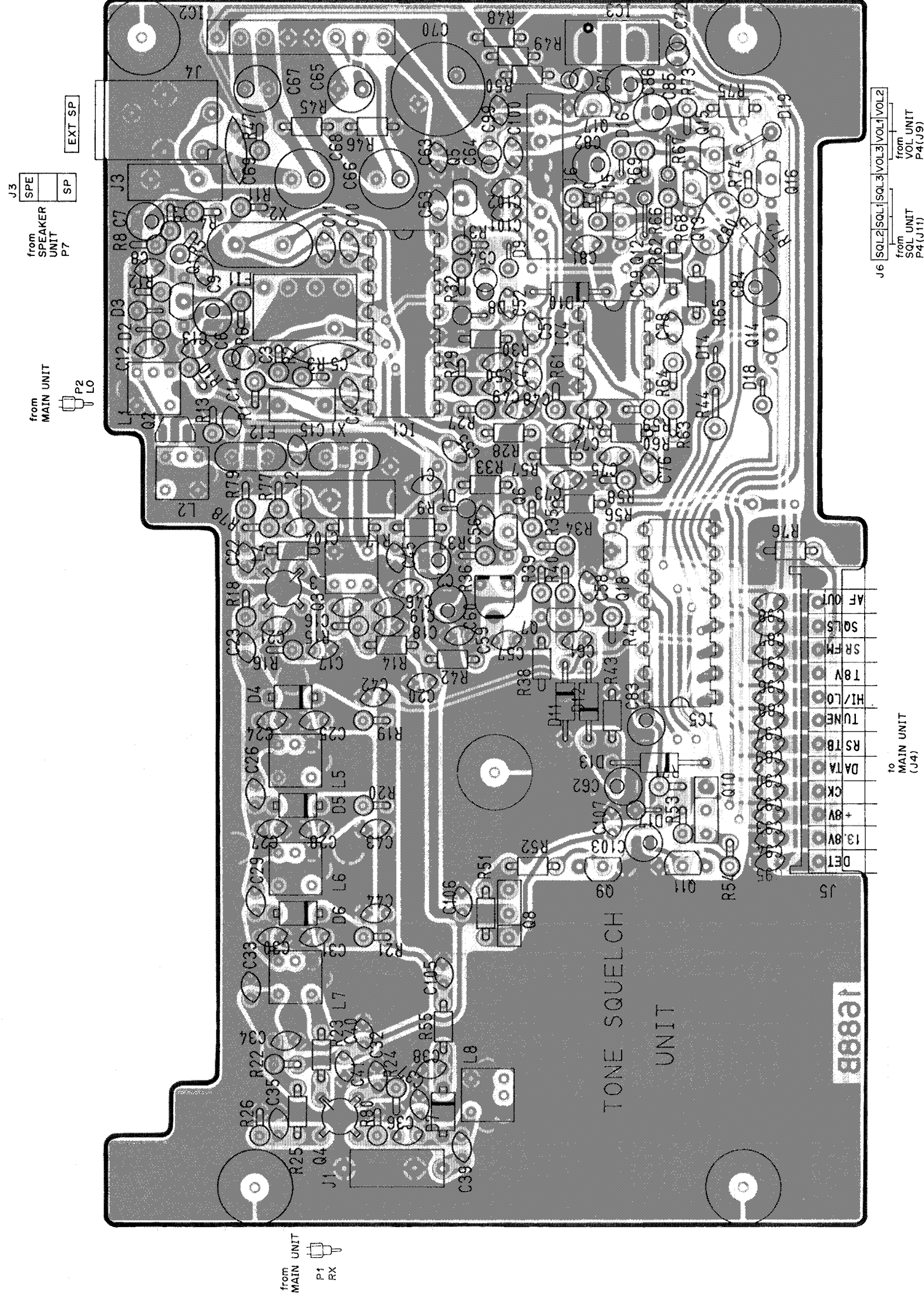
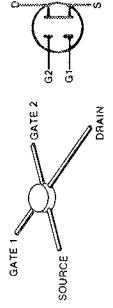
2SK241 GR
Q2



RN1204
Q9, Q11
Q14, Q16
Q17



3SK174 L
Q3, Q4



SECTION 8 PARTS LIST

[EF UNIT]

[EF UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	µPD75308GF-101-3B9
IC2	IC	M51943BML
IC3	IC	LA6393M
IC4	IC	TC4581F
Q1	Transistor	2SC2712 Y
Q2	Transistor	2SC2712 Y
Q3	Transistor	FN2404
Q4	Transistor	2SC2712 Y
Q5	Transistor	2SC2712 Y
Q8	Transistor	FN2404
Q9	Transistor	FN2404
Q10	Transistor	2SC2712 Y
Q11	Transistor	2SB798 DK
Q12	Transistor	2SC2712 Y
Q13	Transistor	FN2404
Q14	Transistor	2SC2712 Y
Q15	Transistor	2SC2712 Y
D1	Diode	1SS184
D2	Diode	1SS184
D3	Diode	1SS184
D4	Diode	1SS184
D5	Diode	1SS184
D6	Diode	1SS184
D7	Diode	1SS196 (C-228A: U.S.A., Asia)
D8	Diode	1SS184 (C-228E: Italy)
D8	Diode	1SS193 (C-228A: Australia)
D8	Diode	1SS196 (C-228E: Germany)
D9	Diode	1SS193
D11	Diode	(C-228A/E: Australia, Germany, Italy)
D12	Diode	1SS184
D13	Diode	1SS193
D14	Diode	1SS193
D15	Diode	1SS184
D15	Diode	1SS181
D16	Diode	1SS193
D17	Diode	1SS181
D18	Zener	RD9-1M B2
D19	Diode	1SS254
X1	Crystal	FAR-C4CA-04194-000-M01
R1	Variable Resistor	RK0971112005A
R2	Variable Resistor	RK0971114005A
R3	Resistor	47KΩ MCR10
R4	Resistor	47KΩ MCR10
R5	Resistor	47KΩ MCR10
R6	Resistor	47KΩ MCR10
R7	Resistor	47KΩ MCR10
R8	Resistor	47KΩ MCR10
R9	Resistor	15KΩ MCR10
R10	Resistor	1MΩ MCR10
R11	Resistor	8.2KΩ MCR10
R12	Resistor	100KΩ MCR10
R13	Resistor	1.2MΩ MCR10
R14	Resistor	1KΩ MCR10
R15	Resistor	100KΩ MCR10
R16	Resistor	100KΩ MCR10
R17	Resistor	100KΩ MCR10
R18	Resistor	4.7KΩ MCR10
R19	Resistor	220KΩ MCR10
R20	Resistor	3.3KΩ MCR10
R21	Resistor	2.7KΩ MCR10
R22	Resistor	82KΩ MCR10

REF. NO.	DESCRIPTION	PART NO.
R23	Resistor	27KΩ MCR10
R24	Resistor	56KΩ MCR10
R25	Resistor	27KΩ MCR10
R26	Resistor	1.2KΩ MCR10
R27	Resistor	1.8KΩ MCR10
R28	Resistor	220Ω R50X
R29	Resistor	100KΩ MCR10
R30	Resistor	220Ω MCR10
R31	Resistor	3.9KΩ MCR10
R32	Resistor	1KΩ MCR10
R33	Resistor	3.3KΩ MCR10
R34	Resistor	330Ω MCR10
R35	Resistor	180Ω MCR10
R36	Resistor	100KΩ MCR10
R37	Resistor	100KΩ MCR10
R39	Resistor	100KΩ MCR10
R40	Resistor	33Ω MCR10
R41	Resistor	100KΩ MCR10
R42	Resistor	100KΩ MCR10
R43	Resistor	470KΩ MCR10
R44	Resistor	150KΩ MCR10
C1	Ceramic	0.1µF GRM40 F
C2	Electrolytic	47µF 6.3V MS7
C3	Ceramic	330pF GRM40 CH
C4	Ceramic	0.001µF GRM40
C5	Ceramic	0.001µF GRM40
C6	Ceramic	0.01µF GRM40 F
C7	Ceramic	0.001µF GRM40
C8	Electrolytic	47µF 6.3V MS7
C9	Ceramic	0.001µF GRM40
C10	Ceramic	0.001µF GRM40
C11	Ceramic	0.001µF GRM40
C12	Ceramic	0.001µF GRM40
C13	Ceramic	0.001µF GRM40
C14	Ceramic	0.001µF GRM40
C15	Ceramic	0.001µF GRM40
C16	Barrier Layer	0.1µF 16V
J1	Connector	8S-S-E
J2	Connector	TLB-P07H-B1
J3	Connector	TLB-P06H-B1
J4	Connector	TLB-P04H-B1
J5	Connector	B03B-EH-S
J6	Connector	TXL-P03P-C1
J7	Connector	TXL-P03P-C1
J8	Connector	TLB-P03H-B1
J9	Connector	TLB-P03H-B1
J10	Connector	TZB-P02H-A1
J11	Connector	TLB-P03H-B1
J12	Connector	TZB-P02H-A1
P1	Connector	TXL-P06H-A1
P2	Connector	TXL-P13H-A1
P3	Connector	EHR-03
P4	Connector	EHR-06
P5	Connector	TXL-P03H-A1
P6	Connector	TXL-P03H-A1
P7	Connector	EHR-03
DS1	LCD	LCD-9811J
DS2	Lamp	HRS-7219A-Y2 30
DS3	Lamp	HRS-7219A-Y2 30
DS4	Lamp	HRS-7219A-Y2 30
DS5	LED	SLP-251B
DS6	LED	SLP-151B

[EF UNIT]

REF. NO.	DESCRIPTION	PART NO.
S1	Switch	SKHHAK013A
S2	Switch	HKW0270-01-300
S3	Switch	SKHLAB064A
S4	Switch	HKW0270-01-300
S5	Switch	HKW0270-01-300
S6	Switch	HKW0270-01-300
S7	Switch	SKHLAB064A
S8	Switch	HKW0270-01-300
S9	Switch	SKHLAB064A
S10	Switch	HKW0270-01-300
S11	Rotary Encoder	SRBM1L038A
SP1	Speaker	57S38-1
BT1	Lithium Battery	BR2032-1T2
EP1	P.C. Board	B-1655B (LOGIC)
EP2	P.C. Board	B-1694B (VOLUME)
EP3	P.C. Board	B-1695B (SQUELCH)
EP4	P.C. Board	B-1696A (SENSOR)
EP5	LCD Contact Strip	SRCN543

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	SC-1019 (IC-228A/E) SC-1022 (IC-228H)
IC2	IC	μPC358C
IC3	IC	PLL2001
IC4	IC	TA78L005AP
IC5	IC	μPD4094BC (IC-228A: U.S.A., Asia)
IC6	IC	S7116A (IC-228A: U.S.A., Asia)
IC7	IC	NJM4558D
Q1	Transistor	2SC2458 GR
Q2	FET	2SK125
Q3	Transistor	2SC3776 D
Q4	Transistor	2SC3776 D
Q5	Transistor	2SC3776 D
Q6	Transistor	2SC2407 (IC-228A/E) TRF559 (IC-228H)
Q7	Transistor	2SC2458L G
Q8	Transistor	2SA1359 Y (IC-228A/E) 2SB1019 (IC-228H)
Q9	Transistor	2SC2458 GR (IC-228A/E) 2SC1645 B
Q10	Transistor	RN1204
Q11	FET	2SK184 Y
Q12	Transistor	2SC2458 GR
Q13	Transistor	2SA1048 GR
Q14	FET	2SK184 Y
Q15	Transistor	2SA1048 GR
Q16	Transistor	2SA1048 GR
Q17	Transistor	2SC2458 GR
Q18	Transistor	2SC2458 GR
Q19	Transistor	2SA1048 GR
Q20	Transistor	2SC2458 GR
D1	Diode	1SS53
D2	Varicap	1SV50E
D3	Varicap	1SV50E
D4	Diode	1SS265
D5	Diode	1SS53

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
D6	Diode	1SS265
D7	Diode	MI308
D8	Diode	MI308
D9	Diode	1SS97
D10	Diode	1SS97
D11	Diode	MI308 (IC-228A/E) MI407 (IC-228H)
D12	Diode	15CD11
D13	Diode	1SS53
D14	Zener	RD20E B2
D15	Diode	1SS133
D16	Diode	1S953
D17	Zener	RD30E B2
D18	Diode	1SS53
D19	Diode	1SS133
X1	Crystal	CR-69
X2	Crystal	RF4A3FAA (IC-228A: U.S.A., Asia)
L1	Coil	3.3μH LAL02KR 3R3K
L2	Coil	3.3μH LAL02KR 3R3K
L3	Coil	LB-167
L4	Coil	3.3μH LAL02KR 3R3K
L5	Coil	3.3μH LAL03NA 3R3K
L6	Coil	3.3μH LAL03NA 3R3K
L7	Coil	LA-244
L8	Coil	LA-234
L9	Coil	LA-244 (IC-228A/E) LA-254 (IC-228H)
L10	Coil	LA-233 (IC-228A/E) LA-235 (IC-228H)
L11	Coil	LA-234
L12	Coil	LA-235
L13	Coil	LA-235
L14	Coil	LA-243
L15	Coil	LA-236
L16	Coil	LA-244
L17	Coil	LW-19
L18	Coil	1mH LAL03NA 102K
L19	Coil	LW-30
L20	Coil	100μH LAL03NA 101K
L21	Coil	LR-116
L22	Coil	LW-19
R1	Resistor	4.7kΩ ELR20
R2	Resistor	2.7kΩ ELR20
R3	Resistor	470Ω ELR20
R4	Resistor	470Ω ELR20
R5	Resistor	47Ω ELR20
R6	Resistor	47Ω ELR20
R7	Resistor	100Ω ELR20
R8	Resistor	4.7kΩ ELR20
R9	Resistor	220Ω ELR20
R10	Resistor	680Ω ELR20
R11	Resistor	47Ω ELR20
R12	Resistor	100Ω R20
R13	Resistor	100Ω ELR20
R14	Resistor	47Ω ELR20
R15	Resistor	4.7kΩ R25
R16	Resistor	680Ω ELR20
R17	Resistor	47Ω R20
R18	Resistor	270Ω R20
R19	Resistor	18Ω R25
R20	Resistor	270Ω ELR20
R21	Resistor	47Ω ELR20
R22	Resistor	4.7kΩ ELR20
R23	Resistor	680Ω ELR20
R24	Resistor	3.3kΩ ELR20
R25	Resistor	1kΩ R20
R26	Resistor	47Ω ELR20
R27	Resistor	2.2kΩ ELR20
R31	Resistor	390Ω R20

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R32	Resistor	150Ω ELR20
R33	Resistor	10kΩ R25
R34	Resistor	10kΩ ELR20
R35	Resistor	47kΩ ELR20
R36	Resistor	33kΩ ELR20
R37	Resistor	330Ω R50X (IC-228A/E) 220Ω R50X (IC-228H)
R38	Resistor	4.7kΩ R20 4.7kΩ CRB25FX (IC-228H)
R39	Resistor	4.7kΩ ELR20
R40	Resistor	4.7kΩ R20 (IC-228A/E) 4.7kΩ CRB25FX (IC-228H)
R41	Resistor	47Ω R50X (IC-228A/E) 33Ω R50X (IC-228H)
R42	Resistor	47Ω R50X (IC-228A/E) 33Ω R50X (IC-228H)
R43	Resistor	2.2kΩ R25
R44	Resistor	270Ω R20
R45	Resistor	10kΩ R20
R46	Resistor	1kΩ ELR20
R47	Resistor	100kΩ ELR20
R48	Resistor	270kΩ ELR20
R49	Resistor	220kΩ ELR20
R50	Resistor	4.7kΩ ELR20
R51	Resistor	15kΩ ELR20
R52	Resistor	56kΩ ELR20
R53	Resistor	270kΩ ELR20
R55	Resistor	220kΩ ELR20
R56	Resistor	2.2MΩ ELR20
R57	Resistor	10Ω R20
R58	Resistor	150kΩ ELR20
R59	Resistor	100kΩ ELR20
R60	Resistor	6.8kΩ ELR20
R61	Resistor	220kΩ ELR20
R62	Resistor	56kΩ ELR20
R63	Resistor	47kΩ ELR20
R64	Resistor	220kΩ ELR20
R65	Resistor	100kΩ ELR20
R66	Resistor	47kΩ ELR20
R67	Resistor	15kΩ ELR20
R68	Resistor	2.2kΩ ELR20
R69	Resistor	68kΩ ELR20
R70	Resistor	10kΩ ELR20
R71	Resistor	470Ω ELR20
R72	Resistor	470Ω ELR20
R73	Resistor	100Ω ELR20
R74	Resistor	15kΩ R25
R75	Resistor	2.2MΩ ELR20
R76	Resistor	56kΩ R20
R77	Resistor	680Ω ELR20
R78	Resistor	10kΩ R20
R79	Resistor	100kΩ ELR20
R80	Resistor	180kΩ ELR20
R81	Resistor	1.2kΩ ELR20 (IC-228A/E) 1kΩ ELR20 (IC-228H)
R82	Trimmer	3.3kΩ RH0421CN3J01A
R83	Trimmer	2.2kΩ RH0421CJ3J09A
R84	Resistor	390Ω R20 (IC-228A/E) 47Ω R20 (IC-228H)
R85	Resistor	10Ω R20 (IC-228A: U.S.A., Asia)
R86	Resistor	47kΩ RH0651CS4J25A (IC-228A: U.S.A., Asia)
R87	Resistor	47kΩ ELR20 (IC-228A: U.S.A., Asia)
R88	Resistor	47kΩ R20 (IC-228A: U.S.A., Asia)
R89	Resistor	5.6kΩ ELR20
R90	Trimmer	10kΩ RH0651C14J2WA
R91	Resistor	82kΩ ELR20
R92	Resistor	82kΩ ELR20
R93	Resistor	82kΩ ELR20
R94	Resistor	150kΩ R20
R95	Resistor	47kΩ R25
R96	Resistor	100kΩ ELR20

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.
R97	Resistor	150kΩ R20
R98	Trimmer	100kΩ RH0651C15J1UA
R99	Resistor	1.5kΩ ELR20
R100	Resistor	100Ω ELR20
R101	Resistor	220kΩ ELR20
R102	Resistor	270kΩ ELR20
R103	Resistor	100Ω R25
R104	Resistor	5.6kΩ ELR20
R105	Resistor	1.2MΩ ELR20
R106	Resistor	330Ω ELR20
R107	Resistor	1kΩ ELR20
R108	Resistor	100Ω ELR20
R109	Resistor	4.7kΩ ELR20
R110	Resistor	10Ω ELR20 (IC-228A/E only)
R111	Resistor	330Ω ELR20 (IC-228A/E only)
C1	Electrolytic	100μF 10V SS
C2	Ceramic	470pF 50V
C3	Ceramic	0.001μF 50V
C4	Ceramic	470pF 50V
C5	Ceramic	470pF 50V
C6	Tantalum	4.7μF 16V DN
C7	Ceramic	470pF 50V
C8	Ceramic	1pF 50V
C9	Ceramic	0.001μF 50V
C10	Ceramic	0.001μF 50V
C11	Ceramic	1pF 50V
C12	Ceramic	100pF 50V
C13	Ceramic	470pF 50V
C14	Ceramic	22pF 50V
C15	Ceramic	470pF 50V
C16	Ceramic	470pF 50V
C17	Cylinder	22pF UP125 SL 220J
C18	Ceramic	5pF 50V
C19	Cylinder	5.6pF UP125 SL 5R6K
C20	Ceramic	10pF 50V
C21	Ceramic	22pF 50V
C22	Ceramic	12pF 50V
C23	Ceramic	20pF 50V (IC-228A/E) 30pF 50V (IC-228H)
C24	Ceramic	470pF 50V
C25	Ceramic	470pF 50V
C26	Ceramic	470pF 50V
C29	Ceramic	470pF 50V
C30	Ceramic	470pF 50V
C31	Ceramic	22pF 50V
C32	Ceramic	10pF 50V
C33	Ceramic	22pF 50V
C34	Ceramic	470pF 50V
C35	Ceramic	0.001μF 50V
C36	Ceramic	470pF 50V
C37	Ceramic	0.001μF 50V
C38	Tantalum	10μF 35V DN
C39	Ceramic	470pF 50V
C40	Electrolytic	10μF 16V MS7
C41	Ceramic	0.001μF 50V
C42	Ceramic	0.001μF 50V
C43	Ceramic	22pF 500V (IC-228A/E) 12pF 500V (IC-228H)
C44	Ceramic	1pF 50V (IC-228A/E) 2pF 50V UJ (IC-228H)
C45	Ceramic	2pF 500V (IC-228H only)
C46	Ceramic	20pF 50V CH (IC-228A/H) 27pF 50V CH (IC-228H)
C47	Ceramic	20pF 50V CH (IC-228A/H) 27pF 50V CH (IC-228H)
C48	Ceramic	1pF 50V (IC-228A/E) 2pF 50V UJ (IC-228H)
C49	Ceramic	2pF 500V (IC-228H only)
C50	Ceramic	0.001μF 50V
C51	Ceramic	0.001μF 50V
C52	Ceramic	470pF 50V
C53	Ceramic	0.001μF 50V
C54	Ceramic	470pF 50V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C55	Ceramic	12pF	500V
C56	Ceramic	0.001μF	500V
C57	Ceramic	22pF	500V (IC-228A/E)
		18pF	500V (IC-228H)
C58	Ceramic	39pF	50V
C59	Ceramic	20pF	50V
C60	Ceramic	100pF	50V
C61	Ceramic	15pF	500V
C62	Ceramic	30pF	500V
C63	Ceramic	30pF	500V
C64	Ceramic	10pF	500V
C65	Ceramic	0.001μF	50V
C66	Ceramic	470pF	50V
C67	Ceramic	0.001μF	50V
C68	Ceramic	470pF	50V
C69	Ceramic	0.001μF	50V
C70	Ceramic	220pF	50V
C71	Electrolytic	330μF	16V SS
C72	Electrolytic	330μF	16V SS
C73	Electrolytic	330μF	16V SS
C74	Feed Through	0.001μF	TF318-450E 102GMV
C75	Tantalum	0.1μF	35V DN
C76	Tantalum	10μF	35V DN
C77	Tantalum	2.2μF	35V DN
C78	Tantalum	10μF	35V DN
C79	Electrolytic	4.7μF	25V MS7
C80	Electrolytic	1μF	50V MS7
C81	Ceramic	0.001μF	50V
C82	Electrolytic	47μF	25V MS9
C83	Ceramic	22pF	50V
C84	Ceramic	18pF	50V
C85	Trimmer	20pF	CV05D2001
C86	Ceramic	27pF	50V
C87	Ceramic	0.001μF	50V
C88	Electrolytic	10μF	16V MS7
C89	Ceramic	100pF	50V
C90	Electrolytic	3.3μF	50V MS7
C91	Electrolytic	3.3μF	50V MS7
C92	Ceramic	0.001μF	50V
C93	Barrier Layer	0.01μF	25V
C94	Ceramic	0.001μF	50V
C95	Ceramic	0.001μF	50V
C96	Ceramic	470pF	50V
C97	Ceramic	0.001μF	50V
C98	Ceramic	0.001μF	50V
C99	Ceramic	470pF	50V
C100	Ceramic	0.001μF	50V
C101	Ceramic	470pF	50V
C102	Ceramic	47μF	50V
C103	Ceramic	0.001μF	50V
C104	Electrolytic	22μF	6.3V MS7
C105	Barrier Layer	0.1μF	16V
C106	Electrolytic	10μF	16V MS7
C107	Ceramic	0.001μF	50V
C108	Ceramic	0.001μF	50V
C109	Ceramic	470pF	50V
C110	Ceramic	0.001μF	50V
C111	Ceramic	47pF	50V
C112	Electrolytic	2.2μF	50V MS7
		(IC-228A: U.S.A., Asia)	
C113	Ceramic	0.001μF	50V
		(IC-228A: U.S.A., Asia)	
C114	Ceramic	39pF	50V
		(IC-228A: U.S.A., Asia)	
C115	Ceramic	39pF	50V
		(IC-228A: U.S.A., Asia)	
C116	Barrier Layer	0.01μF	25V
		(IC-228A: U.S.A., Asia)	
C117	Electrolytic	0.1μF	50V MS7
		(IC-228A: U.S.A., Asia)	
C118	Electrolytic	4.7μF	25V MS7
C119	Ceramic	120pF	50V
C120	Barrier Layer	0.0022μF	25V
C121	Electrolytic	4.7μF	25V MS7
C122	Ceramic	0.001μF	50V

[MAIN UNIT]

REF. NO.	DESCRIPTION	PART NO.	
C123	Barrier Layer	0.001μF	25V
C124	Ceramic	470pF	50V
C125	Electrolytic	1μF	50V BP
C126	Ceramic	470pF	50V
C127	Electrolytic	0.22μF	50V MS7
C128	Ceramic	470pF	50V
C129	Barrier Layer	0.01μF	25V
C130	Ceramic	470pF	50V
C131	Barrier Layer	0.01μF	25V
C132	Ceramic	0.001μF	50V
C133	Ceramic	0.001μF	50V
C134	Electrolytic	10μF	16V MS7
C135	Ceramic	22pF	50V
C136	Ceramic	47pF	50V
C137	Ceramic	47pF	50V
C138	Ceramic	47pF	50V
C139	Ceramic	470pF	50V (IC-228A/E only)
C140	Ceramic	470pF	50V (IC-228A/E only)
C141	Ceramic	22pF	50V (IC-228A/E only)
J1	Connector	TXL-P06P-A1	
J2	Connector	TXL-P13P-A1	
J3	Connector	PD09A10M	
J4	Connector	SB13P-HVQ-24	
P1	Connector	TMP-P01X-A1	
P2	Connector	TMP-P01X-A1	
P3	Connector	PI28A10F	
W1	Cable	OPC-186	
W2	Cable	OPC-143	
W3	Jumper	JPW-01 R01	
W4	Jumper	JPW-01 R01	
W5	Jumper	JPW-01 R01	
W6	Jumper	JPW-01 R01	
W7	Jumper	JPW-01 R01	
W8	Jumper	JPW-01 R01	
W9	Jumper	JPW-01 R01	
W10	Jumper	JPW-01 R01	
W11	Jumper	JPW-01 R01	
W12	Jumper	JPW-01 R01	
W13	Jumper	JPW-01 R01	
W14	Jumper	JPW-02A	
W15	Jumper	JPW-02A	
W16	Shield Cable	{ 61/99/170/C31/W13A }	
W17	(with P1 assembly)	{ 08 A }	
W18	Shield Cable	{ 61/99/170/C31/W13A }	
W19	(with P2 assembly)	{ 08 A }	
W20	Wire	23/00/070/D02/D22	
W21	Wire	23/01/070/D02/D22	
W22	Wire	23/02/070/D02/D22	
W23	Wire	23/03/065/D02/D22	
W24	Wire	23/04/065/D02/D22	
W25	Wire	23/05/065/D02/D22	
W26	Wire	23/06/060/D02/D22	
W27	Wire	23/07/060/D02/D22	
W28	Wire	23/08/060/D02/D22	
W29	Jumper	JPW-02A (IC-228A/E only)	
EP1	Ferrite Bead	DL2-OP2.6-3-1.2H	
EP2	Ferrite Bead	DL2-OP2.6-3-1.2H	
EP9	Crystal	Crystal Seat 4124	
EP10	Crystal	Crystal Seat 4124	
EP11	P.C. Board	B-1680B (MAIN) (IC-228A/E)	
		B-1653B (MAIN) (IC-228H)	

[RX UNIT]

REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MC3357P
IC2	IC	μ PC1242H
IC3	IC	AN6541
IC4	IC	NJM4558D
IC5	IC	μ PD4094BC
Q1	Transistor	2SC2668 O
Q2	FET	2SK241 GR
Q3	FET	3SK174 L
Q4	FET	3SK174 L
Q5	Transistor	2SC2458 GR
Q6	Transistor	2SC2458 GR
Q7	Transistor	2SC2458 GR
Q8	Transistor	2SB909M Q/R
Q9	Transistor	RN1204
Q10	Transistor	2SB909M Q/R
Q11	Transistor	RN1204
Q12	Transistor	RN2204
Q13	Transistor	2SC2458 GR
Q14	Transistor	RN1204
Q15	FET	2SJ105 GR
Q16	Transistor	RN1204
Q17	Transistor	RN1204
Q18	Transistor	RN2204
D1	Zener	RD6.2E B2
D2	Diode	1S953
D3	Diode	1S953
D4	Varicap	1SV50E
D5	Varicap	1SV50E
D6	Varicap	1SV50E
D7	Varicap	1SV50E
D8	Diode	1S953
D9	Diode	1S953
D10	Zener	RD6.2E B2
D11	Diode	1S953
D12	Diode	1S953
D13	Diode	1SS53
D14	Diode	1SS53
D15	Diode	1SS53
D16	Diode	1SS53
D17	Zener	RD5.1E B2
D18	Diode	1SS53
D19	Diode	1SS53
FI1	Ceramic	CFW455E
FI2	Crystal	17M15B
X1	Discriminator	CDB455C7A
X2	Crystal	CR-166
L1	Coil	LS-331
L2	Coil	LS-331
L3	Coil	LS-331
L4	Coil	0.22 μ H LAL02KR R22M
L5	Coil	LS-291
L6	Coil	LS-291
L7	Coil	LS-291
L8	Coil	LS-291
R1	Resistor	1.5k Ω ELR20
R2	Resistor	1.5k Ω ELR20
R3	Resistor	47k Ω ELR20
R4	Resistor	100 Ω ELR20
R5	Resistor	1.5k Ω ELR20
R6	Resistor	1k Ω ELR20
R7	Resistor	56k Ω ELR20
R8	Resistor	18k Ω ELR20
R9	Resistor	100 Ω R20

[RX UNIT]

REF. NO.	DESCRIPTION	PART NO.
R10	Resistor	100 Ω ELR20
R11	Resistor	22k Ω ELR20
R12	Resistor	10k Ω ELR20
R13	Resistor	2.2k Ω ELR20
R14	Resistor	100 Ω R20
R15	Resistor	3.9k Ω ELR20
R16	Resistor	270 Ω ELR20
R17	Resistor	820 Ω R20
R18	Resistor	3.3k Ω ELR20
R19	Resistor	100k Ω ELR20
R20	Resistor	100k Ω ELR20
R21	Resistor	100k Ω ELR20
R22	Resistor	47 Ω ELR20
R23	Resistor	22 Ω R20
R24	Resistor	82 Ω ELR20
R25	Resistor	47k Ω R20
R26	Resistor	10k Ω ELR20
R27	Resistor	470 Ω ELR20
R28	Resistor	470 Ω R20
R29	Resistor	330k Ω ELR20
R30	Resistor	5.6k Ω R20
R31	Resistor	100k Ω ELR20
R32	Resistor	100k Ω ELR20
R33	Resistor	15k Ω R20
R34	Resistor	180k Ω ELR20
R35	Resistor	47k Ω ELR20
R36	Trimmer	4.7k Ω RH0421CS3J08A
R37	Resistor	2.7k Ω ELR20
R38	Resistor	47k Ω R20
R39	Resistor	100k Ω ELR20
R40	Resistor	1.5k Ω ELR20
R41	Resistor	1k Ω ELR20
R42	Resistor	100 Ω R20
R43	Resistor	22k Ω R20
R44	Resistor	47k Ω ELR20
R45	Resistor	1k Ω R20
R46	Resistor	3.3 Ω R20
R47	Resistor	2.2 Ω ELR20
R48	Resistor	1 Ω R20
R49	Resistor	1 Ω R20
R50	Resistor	1 Ω R20
R51	Resistor	10k Ω R20
R52	Resistor	1k Ω R20
R53	Resistor	10k Ω ELR20
R54	Resistor	1k Ω ELR20
R55	Resistor	100k Ω R20
R56	Resistor	470 Ω R20
R57	Resistor	27k Ω R20
R58	Resistor	27k Ω ELR20
R59	Resistor	5.6k Ω ELR20
R60	Resistor	1.2M Ω R20
R61	Resistor	1.2M Ω ELR20
R62	Resistor	100 Ω R20
R63	Resistor	12k Ω ELR20
R64	Resistor	12k Ω ELR20
R65	Resistor	2.7k Ω R20
R66	Resistor	100 Ω ELR20
R67	Resistor	100k Ω ELR20
R68	Resistor	10k Ω ELR20
R69	Resistor	100k Ω ELR20
R70	Resistor	4.7k Ω ELR20
R71	Resistor	220 Ω ELR20
R72	Resistor	4.7k Ω R20
R73	Resistor	10k Ω ELR20
R74	Resistor	220k Ω ELR20
R75	Resistor	470k Ω R20
R76	Resistor	27k Ω R20
R77	Resistor	270 Ω ELR20
R78	Resistor	18 Ω ELR20
R79	Resistor	270 Ω ELR20
R80	Resistor	10k Ω ELR20
C1	Ceramic	0.001 μ F 50V
C2	Electrolytic	4.7 μ F 25V MS7

[RX UNIT]

REF. NO.	DESCRIPTION	PART NO.		
C3	Tantalum	0.1 μ F	35V	DN
C4	Ceramic	82pF	50V	
C5	Barrier Layer	0.1 μ F	16V	
C6	Electrolytic	4.7 μ F	25V	MS7
C7	Electrolytic	0.1 μ F	50V	MS7
C8	Ceramic	120pF	50V	
C9	Ceramic	5pF	50V	
C10	Ceramic	47pF	50V	
C11	Ceramic	120pF	50V	
C12	Ceramic	47pF	50V	
C13	Barrier Layer	0.01 μ F	25V	
C14	Ceramic	68pF	50V	
C15	Ceramic	3pF	50V	
C16	Ceramic	68pF	50V	
C17	Ceramic	0.001 μ F	50V	
C18	Ceramic	0.001 μ F	50V	
C19	Barrier Layer	0.01 μ F	25V	
C20	Ceramic	0.001 μ F	50V	
C21	Ceramic	0.5pF	50V	
C22	Ceramic	7pF	50V	
C23	Ceramic	2pF	50V	
C24	Ceramic	0.35pF	50V	
C25	Ceramic	10pF	50V	
C26	Ceramic	0.5pF	50V	
C27	Ceramic	1pF	50V	
C28	Ceramic	10pF	50V	
C29	Ceramic	0.5pF	50V	
C30	Ceramic	1pF	50V	
C31	Ceramic	10pF	50V	
C32	Ceramic	0.001 μ F	50V	
C33	Ceramic	0.001 μ F	50V	
C34	Ceramic	0.001 μ F	50V	
C35	Ceramic	0.001 μ F	50V	
C36	Ceramic	68pF	50V	
C37	Ceramic	0.5pF	50V	
C38	Ceramic	22pF	50V	
C39	Ceramic	6pF	50V	
C40	Ceramic	0.001 μ F	50V	
C41	Ceramic	470pF	50V	
C42	Ceramic	0.001 μ F	50V	
C43	Ceramic	0.001 μ F	50V	
C44	Ceramic	0.001 μ F	50V	
C45	Ceramic	470pF	50V	
C46	Ceramic	0.001 μ F	50V	
C47	Ceramic	0.001 μ F	50V	
C48	Ceramic	47pF	50V	
C49	Barrier Layer	0.0015 μ F	25V	
C50	Ceramic	33pF	50V	
C51	Barrier Layer	0.0015 μ F	25V	
C52	Barrier Layer	0.01 μ F	25V	
C53	Ceramic	0.001 μ F	50V	
C54	Tantalum	1 μ F	35V	DN
C55	Ceramic	0.001 μ F	50V	
C56	Barrier Layer	0.01 μ F	25V	
C57	Barrier Layer	0.01 μ F	25V	
C58	Barrier Layer	0.01 μ F	25V	
C59	Ceramic	0.001 μ F	50V	
C60	Electrolytic	1 μ F	50V	MS7
C61	Barrier Layer	0.01 μ F	25V	
C62	Electrolytic	10 μ F	10V	MS5
C63	Ceramic	470pF	50V	
C64	Tantalum	0.1 μ F	35V	DN
C65	Electrolytic	47 μ F	16V	SS
C66	Electrolytic	220 μ F	16V	SS
C67	Electrolytic	47 μ F	16V	SS
C68	Electrolytic	220 μ F	16V	SS
C69	Barrier Layer	0.1 μ F	16V	
C70	Electrolytic	470 μ F	16V	SS
C71	Tantalum	1 μ F	35V	DN
C72	Tantalum	4.7 μ F	16V	DN
C73	Ceramic	0.001 μ F	50V	
C74	Barrier Layer	0.01 μ F	25V	
C75	Barrier Layer	0.01 μ F	25V	
C76	Barrier Layer	0.01 μ F	25V	
C77	Barrier Layer	0.01 μ F	25V	

[RX UNIT]

REF. NO.	DESCRIPTION	PART NO.		
C78	Barrier Layer	0.01 μ F	25V	
C79	Barrier Layer	0.0047 μ F	25V	
C80	Mylar	0.056 μ H	563K 50V F2D	
C81	Ceramic	0.001 μ F	50V	
C82	Electrolytic	10 μ F	16V	MS7
C83	Electrolytic	4.7 μ F	25V	MS5
C84	Electrolytic	4.7 μ F	25V	MS7
C85	Electrolytic	1 μ F	50V	MS7
C86	Electrolytic	1 μ F	50V	MS7
C87	Ceramic	0.001 μ F	50V	
C88	Ceramic	0.001 μ F	50V	
C89	Ceramic	47pF	50V	
C90	Ceramic	47pF	50V	
C91	Ceramic	0.001 μ F	50V	
C92	Ceramic	47pF	50V	
C93	Ceramic	0.001 μ F	50V	
C94	Ceramic	0.001 μ F	50V	
C95	Ceramic	0.001 μ F	50V	
C96	Ceramic	0.001 μ F	50V	
C97	Ceramic	0.001 μ F	50V	
C98	Ceramic	0.001 μ F	50V	
C99	Ceramic	0.001 μ F	50V	
C100	Ceramic	0.001 μ F	50V	
C101	Ceramic	0.001 μ F	50V	
C102	Ceramic	0.001 μ F	50V	
C103	Electrolytic	3.3 μ F	50V	MS7
C104	Ceramic	0.001 μ F	50V	
C105	Ceramic	0.001 μ F	50V	
C106	Ceramic	0.001 μ F	50V	
C107	Ceramic	0.001 μ F	50V	
J1	Connector	TMP-J01X-A2		
J2	Connector	TMP-J01X-A2		
J3	Connector	B3B-EH-S		
J4	Connector	HSJ0836-01-010		
J5	Connector	5124-13BH		
J6	Connector	B6B-EH-S		
EP1	P.C. Board	B-1688B (RX)		

SECTION 9 OPTIONAL UNITS

9-1 UT-40 TONE SQUELCH UNIT CIRCUIT DESCRIPTION

9-1-1 GENERAL DESCRIPTION

IC1 is a tone encoder/decoder IC chip that outputs and detects 37 different kinds of tones. A tone is set by serial data from IC1 on the EF UNIT in the IC-228A/E/H transceiver.

IC2 functions as a serial/parallel converter, applying 6-bit parallel data to IC1. The following table shows the relation between frequency and input data in IC1.

OUTPUT FREQUENCY [Hz]	IC1 INPUT PIN NUMBER						OUTPUT FREQUENCY [Hz]	IC1 INPUT PIN NUMBER						OUTPUT FREQUENCY [Hz]	IC1 INPUT PIN NUMBER					
	3	4	5	6	7	8		3	4	5	6	7	8		3	4	5	6	7	8
67.0	H	L	H	H	H	L	110.9	H	L	H	L	H	H	173.8	L	L	L	H	L	H
71.9	L	L	H	H	H	L	114.8	L	L	H	L	H	H	179.9	H	H	H	L	L	H
74.4	H	H	L	H	H	L	118.8	H	H	L	L	H	H	186.2	L	H	H	L	L	H
77.0	L	H	L	H	H	L	123.0	L	H	L	L	H	H	192.8	H	L	H	L	L	H
79.7	H	L	L	H	H	L	127.3	H	L	L	L	H	H	203.5	L	L	H	L	L	H
82.5	L	L	L	H	H	L	131.8	L	L	L	L	H	H	210.7	H	H	L	L	L	H
85.4	H	H	H	L	H	L	136.5	H	H	H	H	L	H	218.1	L	H	L	L	L	H
88.5	L	H	H	L	H	L	141.3	L	H	H	H	L	H	225.7	H	L	L	L	L	H
91.5	H	L	H	L	H	L	146.2	H	L	H	H	L	H	233.6	L	L	L	L	L	H
94.8	H	L	L	H	H	H	151.4	L	L	H	H	L	H	241.8	H	H	H	H	H	L
100.0	L	L	L	H	H	H	156.7	H	H	L	H	L	H	250.3	L	H	H	H	H	L
103.5	H	H	H	L	H	H	162.2	L	H	L	H	L	H	—	—	—	—	—	—	—
107.2	L	H	H	L	H	H	167.9	H	L	L	H	L	H	—	—	—	—	—	—	—

H: HIGH L: LOW

9-1-2 ENCODER CIRCUIT

Pin 26 in IC1 outputs a programmed tone frequency when pin 12 in IC1 becomes "L."

Q4 functions as a buffer amplifier. The collector of Q4 outputs the tone signal and the signal is applied to the VCO circuit to be modulated.

Tone deviation can be adjusted by R10.

9-1-3 DECODER CIRCUIT

Detected signals from pin 9 in IC1 on the RX UNIT of the IC-228A/E/H are applied to pin 29 in IC1 on the UT-40 through the DET line. When the signals have a tone modulated and the tone is matched with the programmed tone frequency by IC2, pin 23 in IC1 changes from "HIGH" to "LOW."

• When the tone squelch function is turned OFF:

Both pins 11 and 12 in IC2 are "HIGH" and +5V are not applied to IC1. Q2 and Q3 turn OFF and the TSQL line is "HIGH."

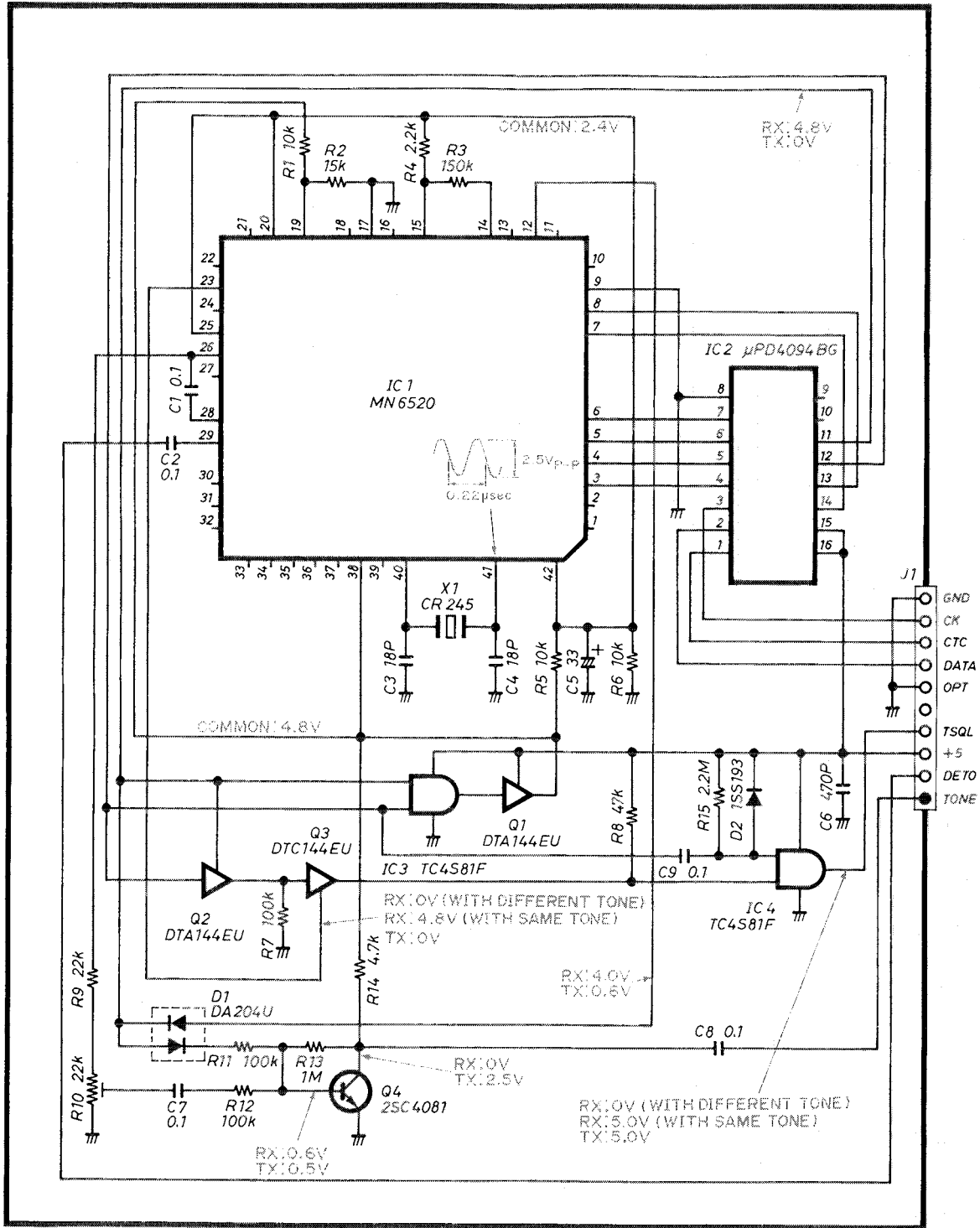
• When the tone squelch function is turned ON:

Pin 11 of IC2 is "HIGH" and pin 12 of IC2 is "LOW." Both Q2 and Q3 turn ON.

When the received tone frequency is not matched with the programmed tone frequency, pin 23 of IC1 is "LOW" and the TSQL line is "LOW."

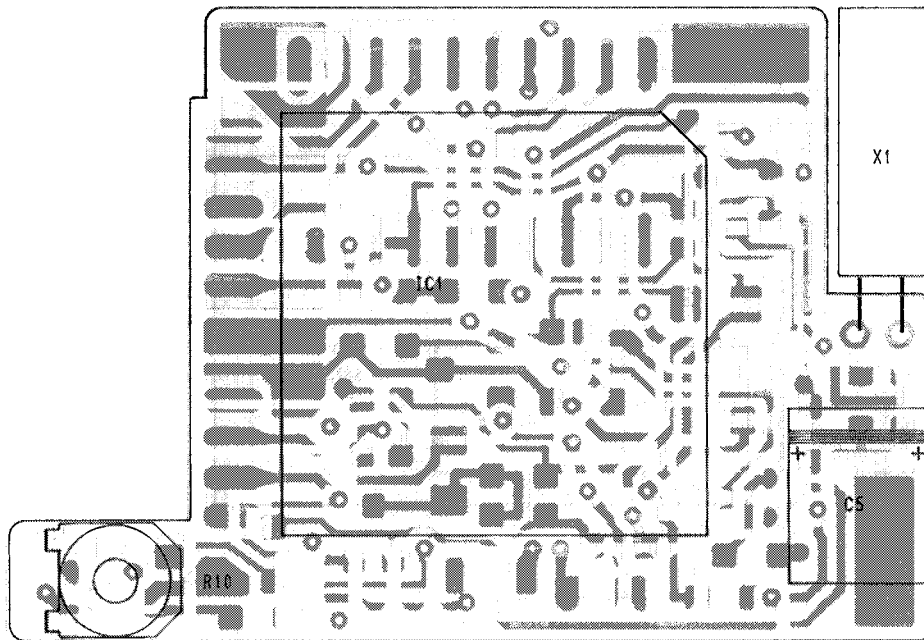
When the received tone frequency is matched with the programmed tone, pin 23 becomes "HIGH" and the TSQL line becomes "HIGH."

9-2 UT-40 VOLTAGE/CIRCUIT DIAGRAM

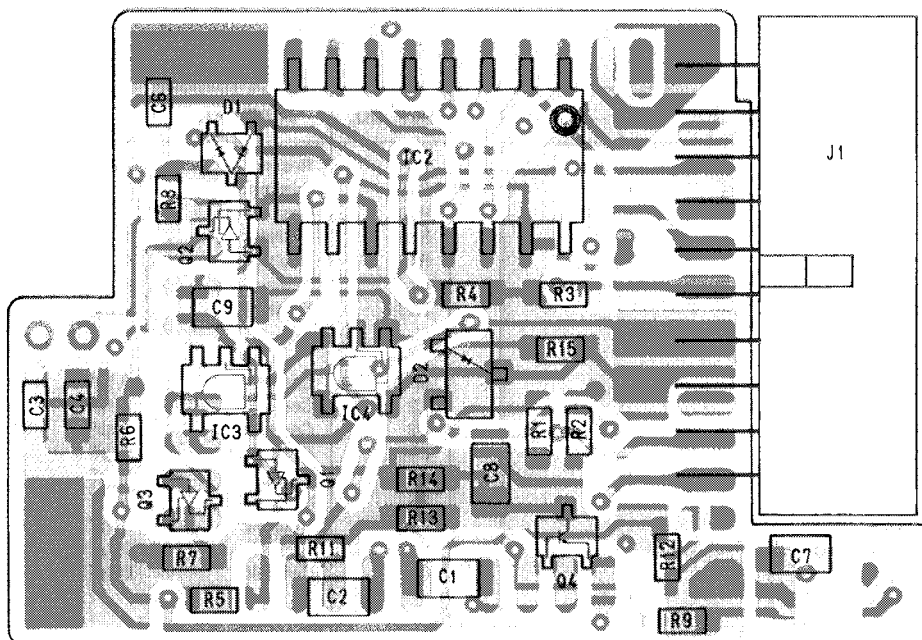


9-3 UT-40 BOARD LAYOUTS

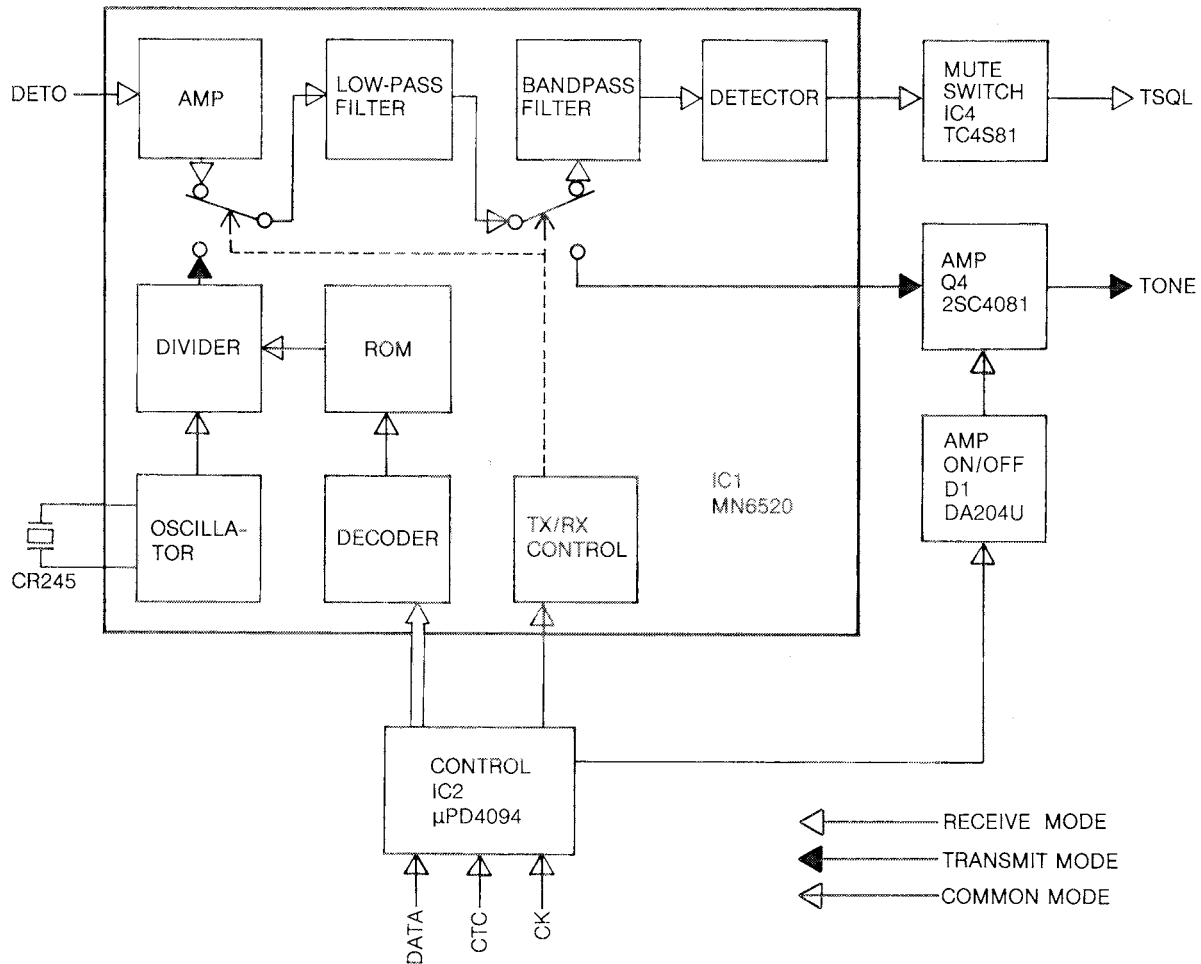
COMPONENT SIDE



FOIL SIDE



9-4 UT-40 BLOCK DIAGRAM



9-5 UT-40 PARTS LIST

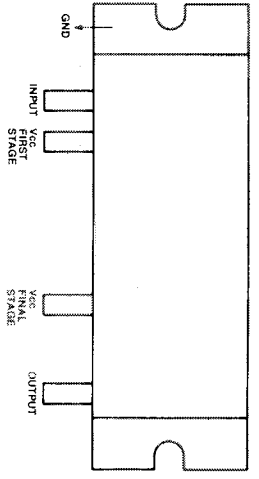
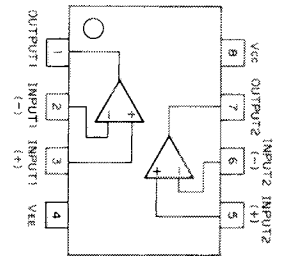
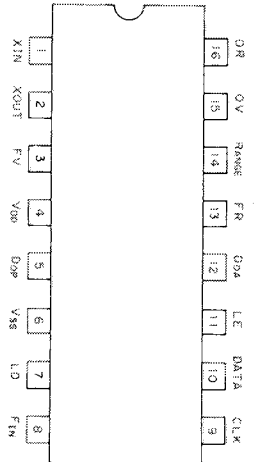
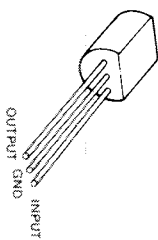
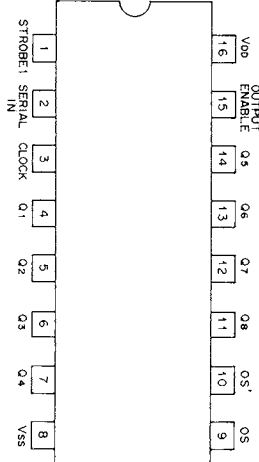
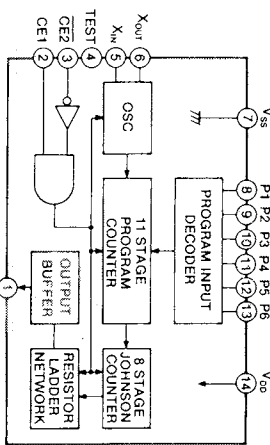
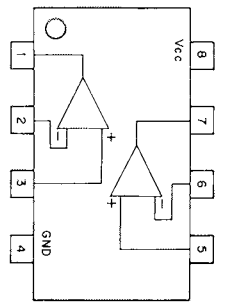
[T. SQL UNIT]

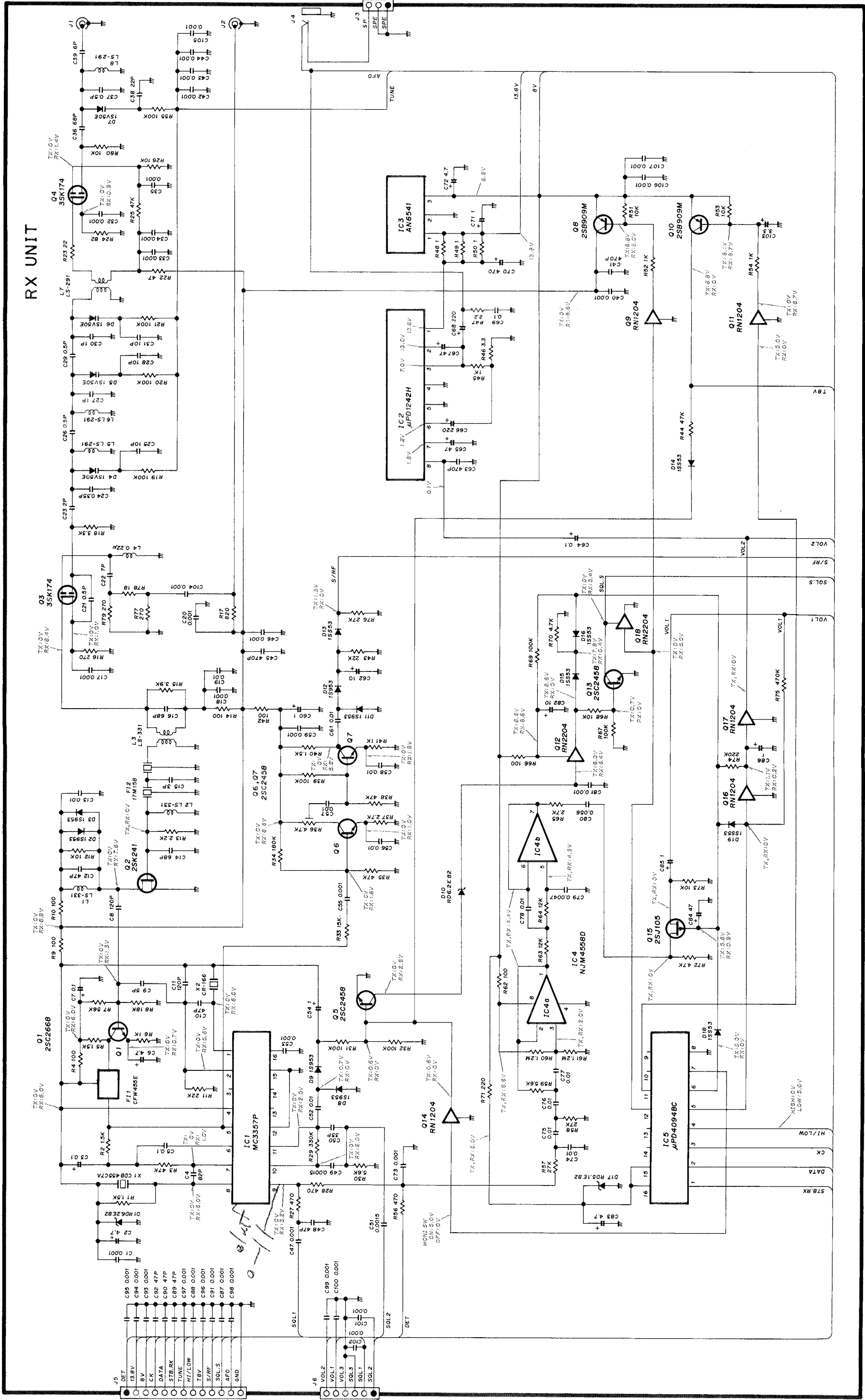
REF. NO.	DESCRIPTION	PART NO.
IC1	IC	MN6520
IC2	IC	μPD4094BG
IC3	IC	TC4S81F
IC4	IC	TC4S81F
Q1	Transistor	DTA144EU
Q2	Transistor	DTA144EU
Q3	Transistor	DTC144EU
Q4	Transistor	2SC4081 R
D1	Diode	DA204U
D2	Diode	1SS193
X1	Crystal	CR245
R1	Resistor	10kΩ MCR03 EZH J
R2	Resistor	15kΩ MCR03 EZH J
R3	Resistor	150kΩ MCR03 EZH J
R4	Resistor	2.2kΩ MCR03 EZH J
R5	Resistor	10kΩ MCR03 EZH J
R6	Resistor	10kΩ MCR03 EZH J
R7	Resistor	100kΩ MCR03 EZH J
R8	Resistor	47kΩ MCR03 EZH J

REF. NO.	DESCRIPTION	PART NO.
R9	Resistor	22kΩ MCR03 EZH J
R10	Trimmer	22kΩ RH04A3AJ4J
R11	Resistor	100kΩ MCR03 EZH J
R12	Resistor	100kΩ MCR03 EZH J
R13	Resistor	1MΩ MCR03 EZH J
R14	Resistor	4.7kΩ MCR03 EZH J
R15	Resistor	2.2MΩ MCR03 EZH J
C1	Ceramic	0.1μF GRM40 F
C2	Ceramic	0.1μF GRM40 F
C3	Ceramic	50μF GRM39 SL 180J
C4	Ceramic	50μF GRM39 SL 180J
C5	Tantalum	33μF TESVC0G336M12L
C6	Ceramic	50μF GRM39 B 471K
C7	Ceramic	0.1μF GRM40 F
C8	Ceramic	0.1μF GRM40 F
C9	Ceramic	0.1μF GRM40 F
J1	Connector	PI28A10M
EP1	P.C. Board	B-1577C

7-2 MAIN UNIT

• IC-228A/E

<p>SC-1019 IC1 (25W VHF RF POWER AMP)</p> 	<p>µPC358C IC2 (DUAL DRIVER)</p> 
<p>PLL2001 IC3 (PLL IC)</p> 	<p>TA78L005AP IC4 (3-TERMINAL 5V REGULATOR)</p> 
<p>µPD4094BC (IC-228A: U.S.A., Asia) IC5 (8-STAGE SHIFT REGISTER)</p> 	<p>ST116A (IC-228A: U.S.A., Asia) IC6 (PROGRAMMABLE TONE GENERATOR)</p> 
<p>NUM4558D IC7 (DUAL NOISE LOW AMP)</p> 	

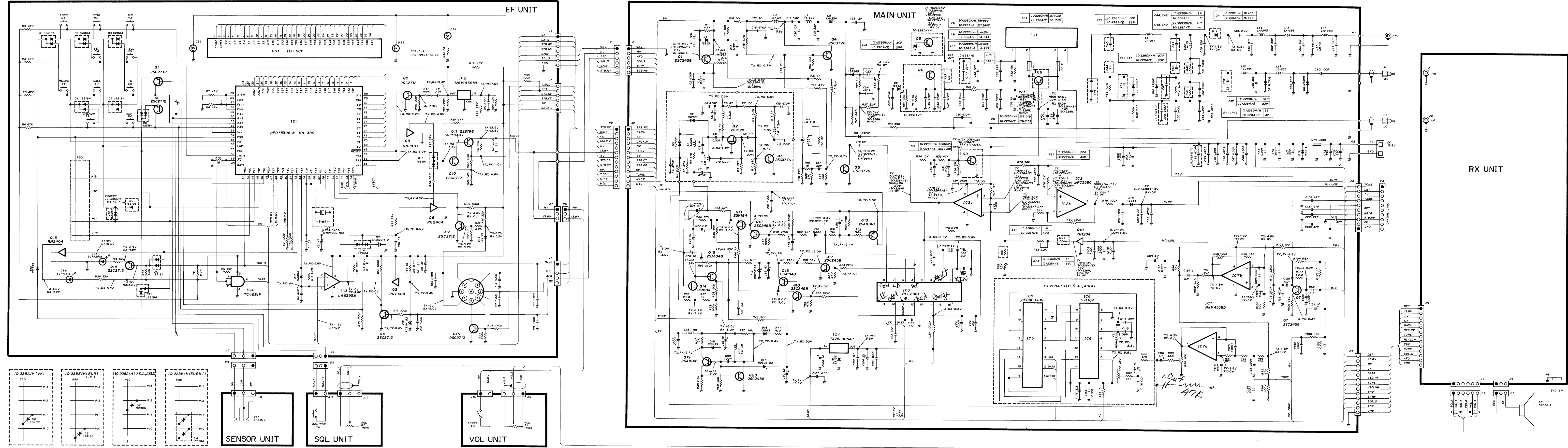


RX UNIT

TX UNIT

SECTION 10 VOLTAGE DIAGRAM

• EF AND MAIN UNITS



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